Starduster

MAGAZINE

Dedicated to the
ACTIVE Homebuilders

JULY 1992

Bill Clouse
Stolp Starduster Corporation
4301 Twning
Flabob Airport
Riverside, California 92509

PREZ'S COMMENTS

Our May Starduster Open House was a big success! Many thanks go out to those who flew in and those who make such an event a success.

I am most greatful to those who traveled from far and near to attend.

Larry Rydberg, Les Homan and Hank Schemeal once again pleased many with demo rides.

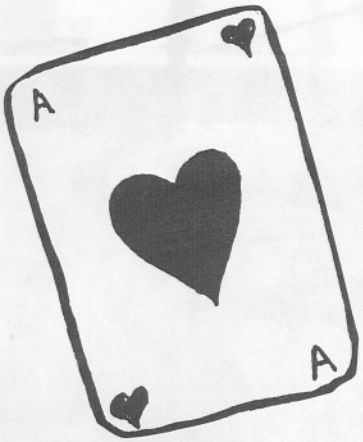
The National Biplane Fly-in at Bartelville was also great. I had a wonderful time and saw some beautiful airplanes.

Already gearing up for Oshkosh 92' - can't wait to meet new builders & new airplanes and of course all the usuals who contribute so much.

"B.C." President

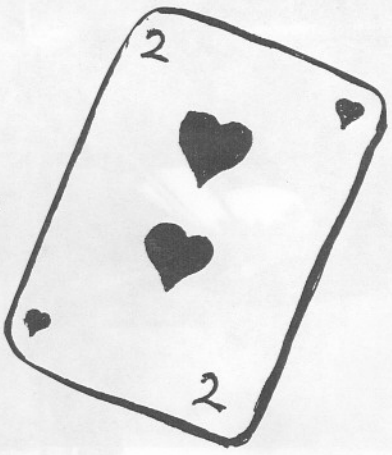
SEE YOU THERE

Where : Acee Ducee Resturant & Tavern
When : Tuesday August 4, 1992
Time : 6:00 - till ?



ACEE DUCEE
DOWNTOWN
OSHKOSH WI

Restaurant & Tavern



JULY 1992

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TABLE OF CONTENTS

We would like to thank all this issues contributers and respond to one and all for some interesting information and photos.

FRONT COVER - N530LR Starduster Too, At the Starduster Open House. Owned by Larry Rydberg of 119 Summerville N.E., Albuquerque, New Mexico 87123.

BACK COVER - N107JC Starduster Too owned by Ed Reinhorn 9650 Jimzel Rd.. La Mesa California 92041. Ed is reported to be the "Head" of the San Diego Glue Angels.

SUBSCRIBE TO STARDUSTER MAGAZINE. PUBLISHED FOR PEOPLE BUILDING OUR AIRPLANES. TECHNICAL INFORMATION, NEWS AND PICTURES. PUBLISHED FOUR TIMES A YEAR. SUBSCRIPTION RATE IS $12.00 PER YEAR. $18.00 PER YEAR FOR OVERSEAS MAILINGS (EXCLUDING CANADA). 1992

THE EDITOR IS ALWAYS LOOKING FOR TECHNICAL TIPS AND EDITORIAL CONTRIBUTIONS TO THIS MAGAZINE. WHICH IS DEDICATED TO THE HOME BUILDER AND SPORT AIRCRAFT ENTHUSIAST. PLEASE INCLUDE YOUR NAME, ADDRESS, TELEPHONE NUMBER AND YOUR "N" NUMBER ALONG WITH ARTICLE SUBMITTED.

ODDS & ENDS FROM YOUR EDITOR

With summer upon us and the airshow season well under way, what things can we do to have a safe and enjoyable summer? Much has been written regarding safety, but do we really pay attention to the advice. Do we really stop and consider our responsiblity to ourselves, our families and guests in our aircraft. There are several things that need to be considered before flying. Such as are we fit to fly, are we legal, is your aircraft in good shape and in current annual, do we have all the information pertinent to the intended flight. This is how we should view each flight.

Aviation is in trouble, and we should not add to its woes by acting irresponsibly.

For those of you like me, who fly your airplane extensively and venture on long cross country flights I can tell you that indepth planning is a must for flying in and out of several busy and hi-density airports that are surrounded by or in ARSA's and TCAS's. The flight planning that went into these trips made them much more enjoyable and less apprehensive.

Some of the simple things that should be with you on every cross country flight you take are; a fire extinguisher, water, food, survival gear and a first aid kit. These things should be easily accessible to the occupants after a forced landing. We pilots need to redouble our efforts to make sure passengers are aware of how to get in and out of their seatbelts and know how to exit the aircraft in the event of this type of occurance.

On the lighter side, your editor has just recently visited with his old flight instructor. Several years ago I saw an article in Western Flyer about the Powder Puff Palms to Pine Air Race, I was happy to see that my old flight instructor Jane Lamar was a participant, and by the way a third place winner as well. During the last several years on our trips to California we kept missing each other. But this year we finally got together. After instructing so many people it is a wonder she would remember any of us, and of course I was happy to report to her that I had not wrecked any airplanes or otherwise brought a discredit to her for FAR violations. We talked about several of the aquaintances that we had shared back at Flabob in the mid to late 60's. It was wonderful to see her again after so many years.

She was a WWII Army Airforce WASP pilot and member of the 99's. She has been a CFI and Double I for many years and was a designated FAA Flight Check Examiner. She still is a currrent CFI although she has recently traded flight instructing for babysitting her daughters children. But she remembers all of her student pilots with fond memories.

D.C.B. Editor

ENGINE COMPONENTS NORTHWEST
23115 AIRPORT ROAD N.E.#2
AURORA, OREGON 97002

ENGINE ACCESSORIES - ITEMS TO BE AWARE OF:

MAGNETOS (Bendix)

*500 Hour Condition Inspection, all series.

*Compliance with Service Bulletin 599D, Inspection of impulse couplings.
- -100 hour intervals if old style riveted cam assembly is installed.
- -500 hour intervals if new style retaining clip cam assembly is installed.

There will be an AD note released before the end of the year referring to this service bulletin. This service bulletin does not apply if you have "Shower of Sparks" ignition system.

MAGNETOS (Slick)

*500 Hour Condition Inspection, all series.

*4000 and 4100 series Magnetos with more than 800 hours Total Time MUST be replaced. Refer Service Bulletin #SB1-88.

WHEN INSTALLING MAGS ON AN ENGINE DO NOT FORGET TO REMOVE THE TIMING PIN OR THE DISTRIBUTOR GEAR COULD BE DAMAGED.

ALTERNATORS

*500 Hour Condition Inspection

- -Comply especially if your aircraft has high power requirements i.e. electric prop deice, electric windscreen deice, radar.
- -Periodically check drive belt condition and wiring security.

*100 Hour Inspection ALV 9400 thru ALV 9410 Prestolite series 100 amp; slip ring end bearing inspection. Refer AD 76-02-07.

*We recommend, if your aircraft is so equipped, start your engine with the alternator switch in the off position. This reduces spike voltage. Bring the alternator on line after rpm has stabilized.

CARBURETORS (Marvel Schebler)

*Installation of metal floats, all series

-Highly recommended if you are using auto gas. Refer: Service Bulletin #MSA-1.
-An AD note has been requested by the manufacturer but has not been released.

*Installation of 1 piece venturi in MA-3 and MA-4 series

-An AD note has been requested by the manufacturer. This AD will be released most likely by the end of this year.

FUEL PUMPS

*Drive coupling pin inspection and replacement every 300 hours TCM E-185 and E-225 engines with Thompson fuel pumps

FUEL INJECTION SERVOS (Bendix)

*Inspection for fuel leakage from impact tubes or venturi every 25 hours until the servo is overhauled. Refer: Service Bulletin PRS-98 applies to all servos manufactured or overhauled prior to 1978.

GENERAL NOTES

ALL ACCESSORIES USED ON TELEDYNE CONTINENTAL MOTORS OR TEXTRON LYCOMING ENGINES, AS A GENERAL RULE, HAVE THE SAME TBO AS THE ENGINE THEY ARE ATTACHED TO. FOR SPECIFIC TBO REQUIREMENTS, FEEL FREE TO CONTACT US.

AT ENGINE OVERHAUL DO NOT FORGET TO HAVE THE ELECTRIC BOOST PUMP LOOKED AT, IF THERE IS ONE INSTALLED ON YOUR AIRCRAFT.

CALL ENGINE COMPONENTS NORTHWEST FOR REPAIR OR OVERHAUL OF ALL YOUR ACCESSORIES.

ENGINE ASSEMBLY TIPS

By Roger Fuchs
Technical Director

If a key engine component such as a crankcase frets or cracks in service, it is tempting to blame the problem on poor design. While no manufacturer design and testing program fully duplicates actual service, there may be other causes for failure which should be considered. From studying crankcases sent in for repair, we at Engine Components Inc. are convinced that improper or inadequate assembly may be the underlying causes of many crankcase problems. Things simply are not always bolted together properly.

Click type torque wrenches can easily give the assembly mechanic a false sense of security. They seem foolproof. We must remember that torque wrenches only measure friction in the fastener, but it is tension (preload) in the fastener that holds engine parts together. Threads with too much friction will not achieve enough tension in the fastener to prevent fretting and cracking or fatigue fractured studs and bolts. Friction variables can easily result in fasteners which are 25 to 50 per cent below desired tension levels. Recommended torque values produce proper fastener tension only when threads are in good condition, free from foreign matter and properly lubricated. When assembling engine parts, DO THE FOLLOWING:

-Use a calibrated tool
-Use the proper parts
-Use the recommended thread lubricant in the proper amount
-Use only clean parts and surfaces
-Use only good parts (no rust, galling, damage; good plating)
-Use the proper torque value and torque sequence
-Assemble when parts are at the proper temperature
-Follow manufacturer's guidelines or other FAA approved data
-DOUBLE CHECK YOUR OWN WORK!

WHO IS ARSA?

If you fly, an Airport Radar Service Area (ARSA) could save your life. If you are a Certified Repair Station, another ARSA could be a "lifesaver". The Aeronautical Repair Station Association, based in Washington, D.C., is an industry association which represents the interests of Repair Stations to the FAA and the Congress. ARSA has taken the lead in helping the FAA to rewrite FAR's and proposed FAA guidelines for weld repair approvals. ARSA is working for product liability reform. Engine Components Inc. has been a member of ARSA for over a year, and I Have been named Chairman of the ARSA General Aviation Council. To be effective, we need YOU as a member.
Call me (503-678-5666) or Sarah MacLeod (202-293-2511) for details.

NEXT MONTH: "Camshaft and Tappet Wear"

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SEVENTH STUD PRODUCT IMPROVEMENT
NOW AVAILABLE!

By Roger Fuchs
Technical Director

Owners of TCM 520-series engines may ask, "What's a seventh stud?" The 520-series cylinders attach to the crankcase by means of two thru-bolts and six cylinder deck studs. Crankcases have long had a tendency to crack around the 2:00 and 4:00 stud holes. Cracks in this area require repair or replacement of the crankcase prior to further flight per TCM Service Bulletin M90-17.

To reduce the likelihood of cracks in these areas, TCM has developed the seventh stud crankcase design. This feature places an additional stud at the 3:00 position between cylinder flanges. The stud clamps the cylinder flanges to the crankcase with a special bracket and spherical nut. This "seventh stud" thus reduces the load carried by the 2:00 and 4:00 studs and, hence, the tendency for cracks to develop in these areas.

Engine Components, Inc. now has FAA engineering approval to incorporate the seventh stud feature on most front alternator (Premold-series) 520 engines having the late heavy crankcase castings. We believe this product improvement will significantly improve the service life of these crankcases. We highly recommend that you request the seventh stud modification when sending these crankcases in for repair. A one-time purchase of a hardware kit is required when making the seventh stud upgrade. Call Gary Tulare or Tim Morland for details.

ENGINE COMPONENTS INC. R & D PROGRAM

The seventh stud modification is just the first of many such Research and Development projects to be completed. Data will be submitted soon to expand the modification to rear-alternator and geared 520 engines also. Other projects underway will establish repair and modification processes for other major internal components of engines and accessories.

Why an R & D program? The average age of the general aviation aircraft is now 23 years and counting. Parts are becoming more expensive; repairs are becoming more necessary. Many product improvements can be made. Engine Components Inc. is committed to keeping your engine airworthy and affordable.

NEXT MONTH: "Engine Assembly Tips" and "Who is ARSA?

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SHAFT AND TAPPET WEAR

By Roger Fuchs
Technical Director

For many years, Continental and Lycoming engines have used steel camshafts and iron-faced tappets. Camshafts are hardened to a generous depth by carburizing and tappet faces are hardened by a "chilling" process in manufacture. Some part numbers have changed in recent years, but basic design and materials remain unchanged and have been proven to be quite reliable in hundreds of thousands of hours in service. When camshafts and tappets work well, they will easily reach engine TBO. When they don't, the wear rate can be quite rapid and the entire engine oil system may become contaminated with metal. Sometimes failures can be very puzzling as in the following true story.

Several years ago an engine overhaul shop called to report that an operator had returned an overhauled TIO-540 engine for warranty. The engine had been built with a reground camshaft and with new FAA-PMA tappets. With about six months and 1,000 hours since the overhaul, both the camshaft and tappets were badly worn and spalled. Within weeks, the company I then worked for received one of its overhauled TIO-540 engines from the same operator with comparable hours and the same problem. The latter engine, however, had been built with a new OEM camshaft and new OEM tappets. We never found out why these parts failed, but we also never found any problem with the parts themselves.

So why do camshafts and tappets wear prematurely? A great deal of conjecture exists on this subject, and many people like to attribute the problem solely to reconditioned parts. Yet, in the above instances, the new parts performed no better. The best answer to the question is probably like the famous pain reliever formula, a "combination of ingredients". Many factors affect the life of camshafts and tappets, the major ones being:

--Engine operation and maintenance
--Crankcase atmosphere
--Lubrication
--Quality of parts

Studies of these factors with respect to aircraft engines are not usually published, camshaft and tappet data being considered proprietary. In the automotive industry, however, camshaft and tappet materials and wear are studied at great lengths and much of the information is published. One such study was published in 1978 by Roy F. Abell of Eaton Corporation.[1] This study makes several key points:

1. A break-in coating is necessary in most applications.

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2. The black oxide coating on the face of tappets is very effective as a break-in surface but also serves to relieve grinding stresses in manufacture due to the high (approximately 1000°F) processing temperature. Relieving stresses reduces the tendency of the tappet face to fatigue and spall.

Another interesting observation by Abell was the experience of one engine manufacturer who was developing a new line of gasoline and diesel engines. Test engines had identical valve train parts, lubricant and test cycles. Wear rates in gasoline engines were negligible while in the diesels they were extremely high. Only frequent oil changes would reduce the wear in the diesels. This marked difference could only come from the effect of combustion by products on parts and oil additives.

A 1989 study by McGeehan and Yamaguchi[2] found that engine blow-by contributed significantly to valve train wear rates. The researches found that water and oxides of nitrogen in combustion by products combined to form nitric acid which attacked anti-wear additives from those studied by McGeehan and Yamaguchi, the effect of blow-by may well be the same. One must also question the effects of agricultural chemicals ingested by engines used in aerial application. At any rate, the study tends to confirm what many of us have observed for years: engines with lots of blow-by tend to be hard on camshafts and tappets.

From these studies and from my own experience, I would make the following observations:

1. Reconditioned camshafts and tappets routinely go to TBO. These parts will perform quite well if care and quality are exercised in reconditioning: proper microfinish, correct contour and profile, grinding free from chatter and burns (overheated areas).

2. Chilled iron tappet faces must be treated with a break-in coating achieved by a high temperature process.

3. Use the Lycoming oil additive faithfully.

4. Keep cylinders in good condition.

5. There is no substitute for regular and frequent engine operation and oil and filter changes. Oil temperature in operation must be high enough for a specified time in order to boil away moisture and acids. Ground running and/or inactivity will produce rust and corrosion on camshaft lobes and tappet faces. Rusted parts will later lead to abrasive wear and spalling. Early camshaft and tappet failure will result. Change oil before an engine is to be out of service for any time and follow manufacturers recommendations for engine preservation for any kind of storage. Remember that chroming of your cylinders will keep them from rusting, but it will not protect your engine's camshaft and tappets.

NEXT MONTH: "Nitralloy guides"

References

[1]I.C. Engine Cam and Tappet Wear Experience, Roy F. Abell,/1978 by Society of Automotive Engineers, Inc., #7700019.

[2]Gasoline-Engine Camshaft Wear: The Culprit is Blow-by, J.A. McGeehan and E.S. Yamaguchi,/ 1989 S.A.E., #892112.

ENGINE COMPONENTS, INC.

ENGINEERING REPORT

CRACKED ALUMINUM AIRCRAFT ENGINE CYLINDER HEADS THE PROBLEM AND THE IFR SOLUTION

THE PROBLEM:

1. A corollary to the aging aircraft issue is the aging aircraft engine cylinder, i.e., cast aluminum heads.

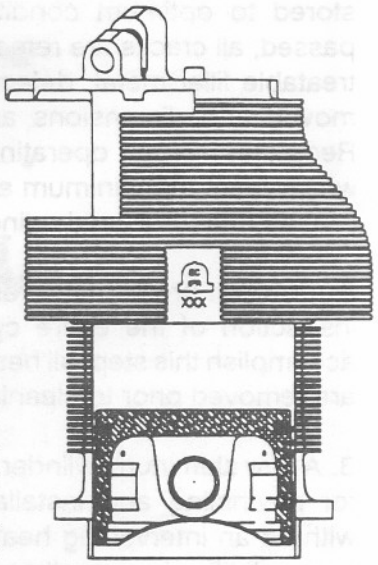
2. New aluminum head castings are porous which reduces actual tensile strength from theoretical by as much as 50%. Foundry techniques for making head castings have not changed over time and can best be described as "art".

3. Porosity varies from cylinder to cylinder and from location to location on a specific cylinder. Massive subsurface casting flaws (porosity) not detected in the manufacturing process can and do cause critical cracks to occur during early hours of cylinder operation. This phenomena is generally referred to as "infant mortality".

4. While massive subsurface defects cause infant mortality, less extensive porosity can cause critical cracks to occur at any time during second, third and subsequent TBO cycles.

5. Surface cracks begin to form almost immediately after a new cylinder is put into operation. These hairline cracks are caused by intergranular corrosion and are most prevalent in the combustion chamber and exhaust port. The root of the crack becomes a stress concentration point which challenges the surrounding metal to contain a non-critical surface crack from growing into a critical structural crack.

6. The ability of a cylinder head to retard crack propagation is referred to as fatigue strength. Unfortunately, as engine operation causes the formation of surface cracks in cylinder heads, it also causes a reduction in fatigue strength due to cyclical stresses generated by the combustion cycle. Fatigue strength is further reduced due to elevated operating temperatures, uneven cylinder heating and cooling as well as shock cooling and over boosting.



7. Aluminum cylinder heads are given elevated yield and tensile properties through heat treatment. Grain size is refined, alloying constituents are put into solution and slip planes are randomly oriented so that the mechanical properties of pure aluminum are significantly improved. However, heat treatment also makes the alloy chemically unstable in the sense that the alloying elements want to precipitate. Time and temperature affect the rate of precipitation, causing grain size to grow and slip planes to align, thereby accelerating crack propagation and intergranular corrosion. Therefore, the benefits of heat treatment are temporary.

8. While aircraft cylinders are routinely returned to service after the absence of aluminum head cracks are confirmed by NDI techniques, industry practice does not confirm the absence of head cracks in the threaded area which interfaces with the cylinder barrel. This practice is justified by field experience but the aging fleet issue can be expected to require more thorough inspection in the future.

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9. Operating history of aircraft cylinders is not recorded meaning that repairable low-time cylinders are often exchanged for yellow-tagged, high-time cylinders. There are no OEM, FAA or industry minimum standards for yield and tensile strength, so return to service determinations ignore all mechanical properties lost due to engine operation.

THE IFR SOLUTION:

1. The IFR (Improved Fatigue Resistance) process is one answer to all of the problems associated with the aging cylinder issue. All areas of the aluminum head are inspected for cracks, mechanical properties are restored to optimum conditions, infant mortality has passed, all cracks are removed or repaired using heat treatable filler metal, defective and soft welds are removed and dimensions are restored to new limits. Regardless of the operating history of cylinder cores which meet the minimum acceptance criteria, the IFR process makes a used cylinder head as reliable as new.

2. The first problem addressed by the IFR process is inspection of the entire cylinder head. In order to accomplish this step, all head parts including the barrel are removed prior to cleaning and inspection.

3. A new aluminum cylinder head casting is not suitable for machining and installation on a cylinder barrel without an intervening heat treatment. Molten aluminum solidifies in a way that results in a non-homegeneous material composition, non-uniform grain size and uneven stresses. All of these undesirable casting properties are minimized through heat treatment and at the same time, yield and tensile strengths are significantly improved. Through a heat treatment process known as reversion, alloying elements in cylinder heads which time and temperature cause to precipitate can be put back into their optimum condition. The reversion process restores cylinder head fatigue strength which is lost during engine operation.

4. Old weld metal is removed from the head and replaced with a heat treatable filler rod. It is a generally accepted industry practice to use a strain hardening filler rod when making weld repairs on aluminum heads. However, elevated temperatures over time relax the compressive stresses in the weld repair, thereby reducing the tensile strength of the weld. Because of the beneficial effects of the reversion process on the HAZ (heat affected zone) created by welding, a stronger, heat treatable filler rod designated Q4, can be selected for all weld repairs.

5. All surfaces in critical areas are polished to remove hairline surface cracks and visually evident corrosion. While new hairline cracks will develop during engine operation, old cracks are eliminated during the IFR process so that the cylinder does not accumulate surface defects from previous use.

THE SUMMARY:

The IFR process represents the first time that fatigue issues have been addressed along with the traditional cylinder repairs commonly practiced in the piston engine industry. Unlike the turbine industry which has considered all of these issues from the beginning, fatigue life has not been addressed when returning critical piston engine components to service. By borrowing from turbine engine technology, Engine Components, Inc. has been able to make a significant improvement to the life expectancy of a piston engine cylinder. ***A CERMISTEEL™ + FREEDOM™ BRAND CYLINDER IS BETTER THAN NEW WITH RESPECT TO THE FOLLOWING FEATURES:***

* Warranty

  One year, unlimited hours, then prorated to TBO, parts and labor.

* Barrel

  New Pratt & Whitney steel which can also be provided with a carbide impregnated bore for better oil consumption and reduced ring wear.

* Head

  The "Infant Mortality" period, a phenomenon associated with all new aluminum castings, has passed and subsurface casting flaws have been repaired.

EC SERVICE INSTRUCTIONS
ENGINE COMPONENTS, INC. SINCE 1943

Technical portions are FAA/DER approved

REPLACES
NO. 89-3-1 DATED 4-12-89 AND NO. 84-11-10 DATED 11-2-84

CYLINDER REMOVAL AND REINSTALLATION

Removing a cylinder in order to perform guide and seat work and then reinstalling the same cylinder creates a special situation. Additionally, different cylinder bore surfaces and piston ring combinations require different break-in techniques. Accordingly, each cylinder bore processed by Engine Components, Inc. will be returned to service according to the following:

A. PLAIN AIRMOTIVE STEEL™ AND NITRIDED STEEL BORES:

Plain Airmotive Steel™ and Nitrided cylinder bores should be returned to service with the following procedures performed prior to installation:

ALWAYS!

1. Hone for ring finish
2. Use new rings
3. Check end gap and side clearance. NOTE: End gap should be checked in choke area as well as in the straight portion of the bore.

B. CHANNELCROMIUM® PROCESS BORES REQUIRE THE FOLLOWING PROCEDURES:

ALWAYS!

1. Hone for ring finish
2. Use new rings
3. Use only cast iron rings without chrome faces
4. Check end gap and side clearance. NOTE: End gap should be checked in choke area as well as in the straight portion of the bore.

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C. CERMICROME® PROCESS CYLINDERS PERMIT THE FOLLOWING OPTIONS:

ALTERNATIVE 1: REUSING SAME PISTON RINGS

1. Leave rings on the piston
2. Inspect rings while installed on the piston to assure there is no excessive wear. The ring outer face should be smooth and without score marks. Should oil ring have sharp rolled edges on the surfaces that contact the cylinder bore, then replacement of the oil ring is recommended. Use of rings from Engine Components, Inc. will assure compatibility with the bore surface. Honing the cylinder is not essential for use of a new oil ring. However, Alternative 2 is acceptable.
3. Inspect Cylinder Bore: Bore should be smooth and without score or scuff marks that can be felt with a fingernail. Should evidence of significant wear be evident, cause should be investigated before reinstalling cylinder.
4. Reuse piston and rings if inspection is satisfactory. If rings are not satisfactory, use Alternative 2.
5. Reinstall cylinder without honing or other processing.

ALTERNATIVE 2: USING NEW PISTON RINGS

Cermicrome process cylinders may be honed for reuse without damage to the bore if care is used. Stick or ball type hones of 200 to 250 grit have been used successfully with a solvent. Dry honing should be avoided since it creates deposits in the bore. Care should be taken to avoid excessive honing since the surface does not show the marks and cross-hatch pattern seen in steel or channel type chrome cylinder bores after honing. A dull mat finish is normal.
Rings normally used for channel type chromium bores, or rings sold by Engine Components, Inc. specifically for Cermicrome process cylinders are recommended.

WARNING: ***Use of rings with chrome faces in Cermicrome or Channelcromium process cylinders will result in engine failure!***

GENERAL NOTES FOR ALL CYLINDER BORES:

A. Procedures in Engine Components, Inc. Service Instruction 84-8-4 are applicable.

B. If high cylinder head or oil temperature persists, or if very high oil consumption is noted after several hours of operation, then successful break-in probably will not occur. Cylinders should be removed, rehoned, and reinstalled with new rings. Break-in procedures should be carefully followed (Ref. SI 85-8-4).

C. Do not reuse rings removed from piston. Cast iron is very brittle and small cracks not visible will eventually result in ring breakage and cylinder failure.

D. Custom gapping of piston rings is a standard procedure. However, ALWAYS break the sharp edges at the ring gap to prevent the ring from digging in to the ring groove and preventing normal rotation.

REPLACES
NO. 89-3-1 DATED 4-12-89 AND NO. 84-11-10 DATED 11-2-84

E. Engine Components, Inc. recommends the following break-in oil:

1. EC Break-In Oil
2. Phillips 20W50XC for opposed engines
3. Phillips 25W60XC for radial engines.
4. Straight Grade Mineral Oil (Preferably ashless dispersant).

NOTE: EC Break-In Oil and Phillips XC Oil are mineral based oils. The ashless dispersant characteristics will suspend the high level of break-in wear particles so they can be carried to the filter. The thinner room temperature viscosity will result in faster lubrication to critical wear areas, but the film strength at operating temperatures is assured by the viscosity index improvers.

Instrument Panels

All pilots at one time or another have wished that they could rearrange their instrument panel. As homebuilders we have ample opportunity to do so. But first lets consider what I believe to be some important points.

(Weight) This should always be a factor. Old WWII gauges usually fit into this category, big and heavy. (Useful) Are we getting what we need in flight instruments and engine gauges, or are we using it because its cheap.

The days of inexpensive surplus WWII gauges have been over for sometime. The cost for flight instruments are pretty well set. You have two choices, new or used (aircraft salvage). I have used both with good success. As for engine gauges new is probably better, as you can get the correct sending units with them. Used engine gauges usually do not come with senders.

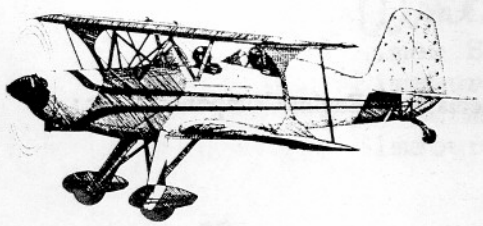
Another thing to look for in gauges are the correct voltage. If your aircraft is powered by a 12 volt to 14 volt alternator, you certainly do not want a 28 volt gauge or any other 28 volt component. I personally prefer mechanical gauges over ones with electrical senders, as I have seen to many break off at the engine or read incorrectly.

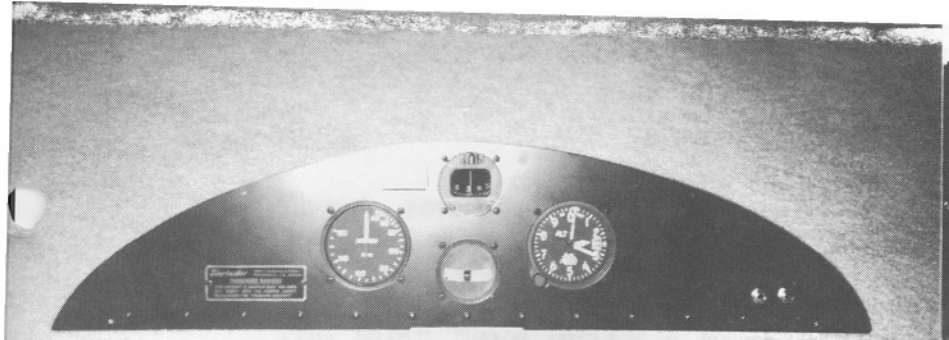
As for laying out your instrument panel I prefer to go with the traditional layout. Changing things just because you want to be different is not such a good idea. Thats why I went with the basic "T" layout. Also my panel is somewhat similar to a C-172. Flight instruments in the middle, with fuel and engine gauges, oil pressure, oil temperature and fuel pressure to the left, and the tachometer, cylinder head, EGT, and the clock on the right. So that if your like most people who have flown a C-172, the instrumentation would be close to what you would be familiar with.

As for the front cockpit, I went with airspeed, altimeter and tachometer. Anymore than that I personally feel is to much. What I forgot to mention is with my basic "T" layout, I deleted the gyro instruments, I.E. Altitude and directional. Room, weight and money being the reason. I only have an electric turn coordinator, and it is for 180 degree turns out of marginal weather. If you are going to fly your bird IFR, then the fuel gyro, basic "T" set up will be required. Included with this article is a drawing of my instrument panels and pictures of several more.

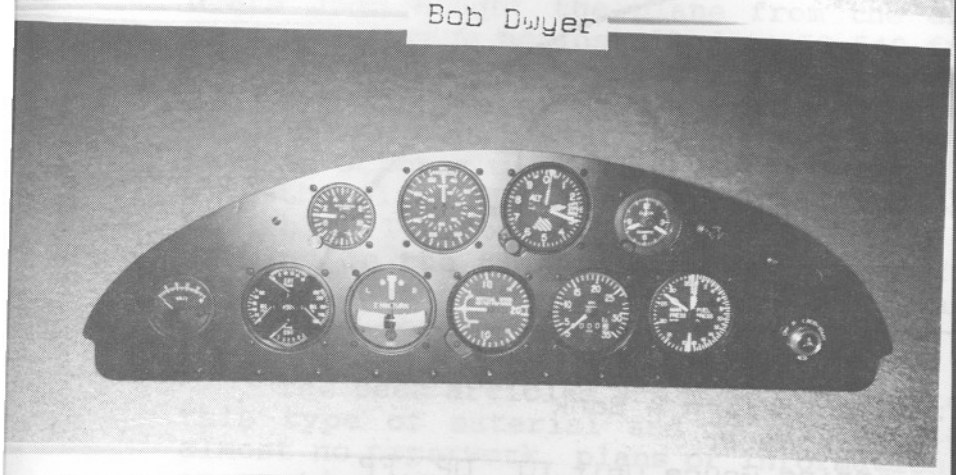
Happy Flying

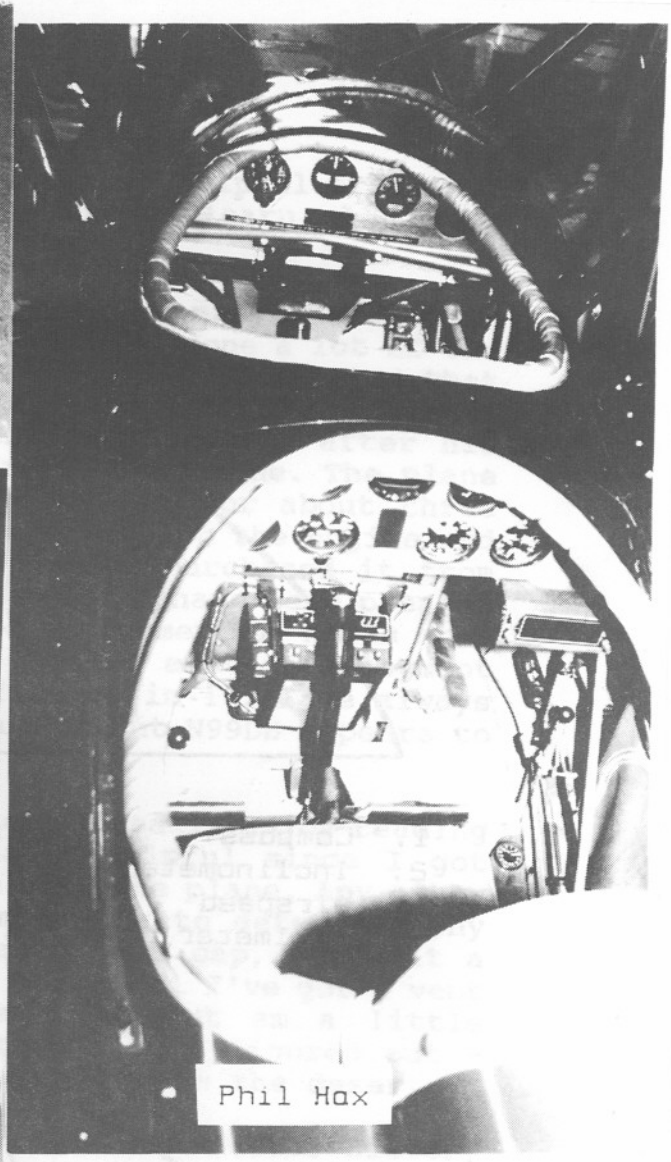
D.C.B. Editor



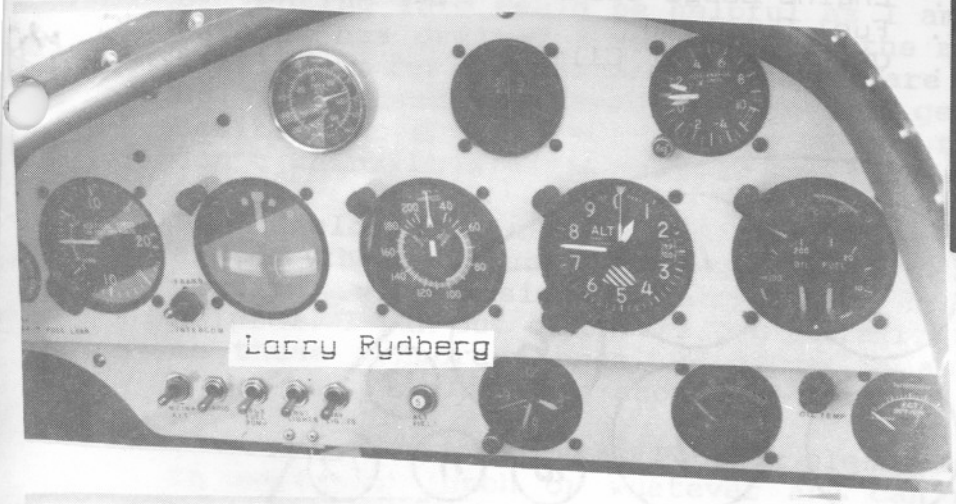


Bob Dwyer



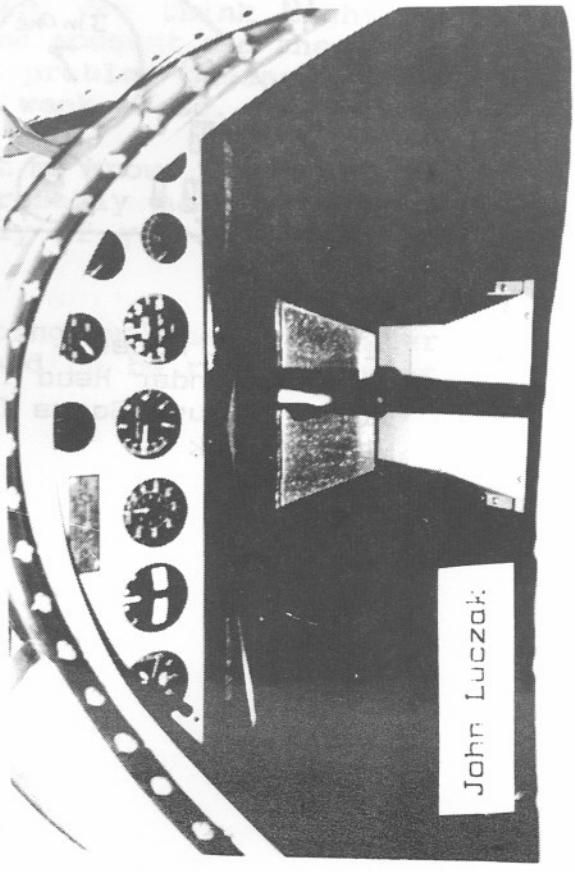


Phil Hax



Larry Rydberg

Gordon Moore's Acroduster

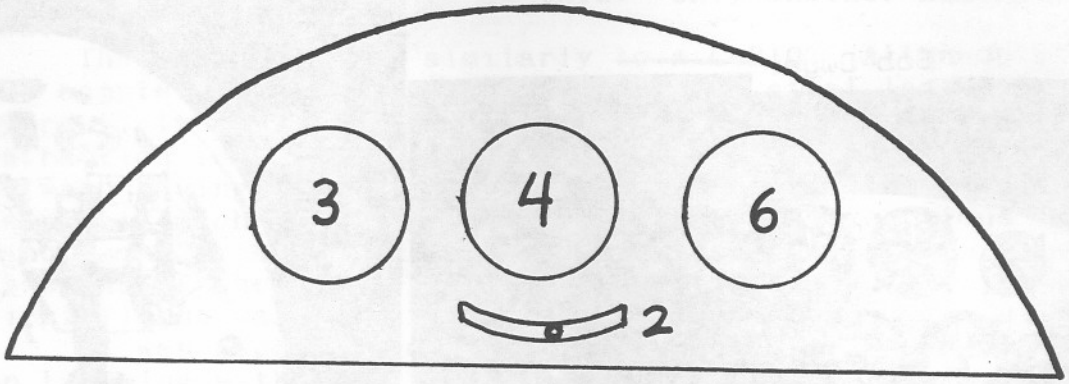


John Luczak

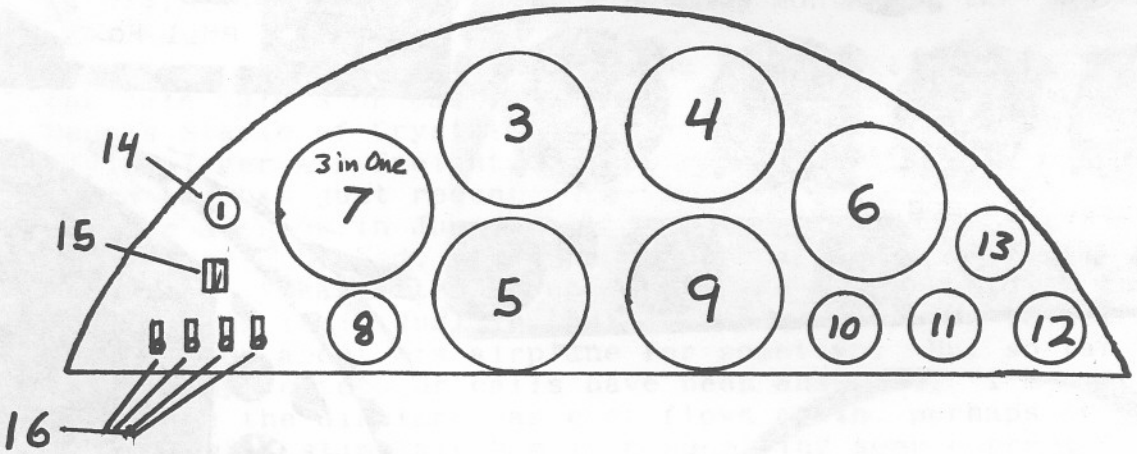
N96576

(1)

Compass Under Center Section



1. Compass
2. Inclinometer
3. Airspeed
4. Altimeter
5. Elect. Turn & Bank
6. Tachometer
7. Engine Gauge Unit OT, OP, FP
8. Fuel Quantity
9. VSI & Rate of Climb



10. Volt Meter
11. Cylinder Head Temp.
12. Exhaust Gases Temp.
13. Clock
14. Mag Switch
15. Master Switch
16. On/Off Toggle Switch
    Nav Strobe Switch
    Landing Light
    Boost Pump

Editor's Starduster Too

Dear Dave,

Thank you for the nice letter and the most helpful articles. I am new to Stardusters and am most anxious to learn all I can about my new to me plane.

You must have quite a memory to remember as many Stardusters as you do. I am quite happy to hear that you have done a lot of the welding on N99DB. I have talked with John Kruger who indicated that Bill Hill also was involved with the construction. After Del Bliss' death John bought the plane from the estate. Sometime after his spin experience he installed an IO 540 from a Commanche. The plane was later sold to Skywatchers Assoc. who had it for about three years. During this time they did a major overhaul on the engine and prop as well as putting in a new rear panel. I purchased it from them in October with about 130 hrs SMOH. So far I have been pleased with the plane. It seems strong and a good performer but needs some TLC which I am busily getting into. I'm getting alot of enjoyment working on the plane plus much more confidence in it. I've always been apprehensive of other peoples homebuilts but N99DB appears to be a good strong honest plane.

The tech articles are most appreciated. I really enjoy reading this type of material and it is especially helpful since I got almost no paperwork, plans or information with the plane. Any other or venting info would be helpful as I am trying to determine why someone has drilled a vent hole in the main tank cap, makes it a little wet for the passenger when you are inverted. I've got a vent up the cabane and another down the gear leg but am a little hesitant to change caps until I've got thinks well figured out - don't think this would be much fun to dead stick in the desert.

Enclosed is a check for $45 for postage, Starduster History and if there is any leftover for any tech tips on alternators, venting, wing design explanation or ? that you think might be helpful. I ran out of checks for the airplane account and they gave me these temporary ones. If there is any problem please let me know, the regular ones should be here in a week or so.

If you are coming to Phoenix please let me know. We would like to meet for lunch or whatever and can probably help with some transportation from the airport, especially if you come to Deer Valley Airport.

Thanks for the great job you are doing on the Starduster Magazine. In this age of plastic people need to be reminded what great airplanes are made of.

Happy flying.

Dick-

Dick Heath

3201 West Peoria
Suite A104
Phoenix, Arizona 85029

602/870-1627 (evenings)
602/866-0663 (work)

STARDUSTER HISTORY

N741S

SA-300 Retractable Gear Serial #49

When I worked for Lou Stolp during the late 1960's we employees joked about building a retractable gear Starduster Too. Little did we know that a flying Tiger Captain by the name of Jack Swan was well on his way to completing his SA-300 RG. What made him do this? Only another homebuilder would understand.

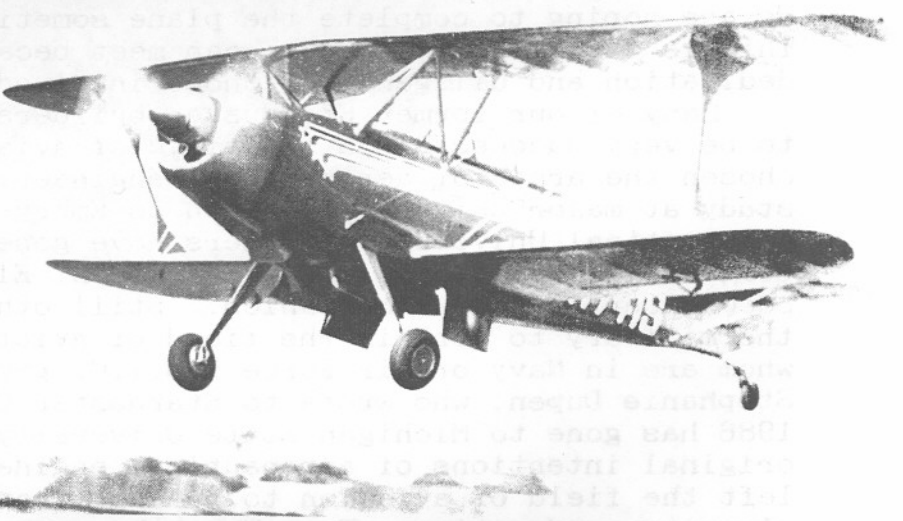
The gear retracts similarly to a C-210. Although it was completely hand built by using C-140 steel legs and is hydraulicly operated by an accumulator that is hand pumped. Retraction is fast, and there is a 10 to 13 mph difference between having the gear up or the gear down. The airplane is pretty much to the plans, but with a few exceptions. The canopy and ailerons on the lower wing are different. It was also one of the very first Starduster Too's to fly, its first flight was in April of 1969.

It was reported to fly at 150 mph, power was a 0360 180 hp Lycoming with a Hartzell constant speed prop. It was and is an airshow stopper. To my knowledge it is the only SA-300 with a retractable gear.

Another interesting fact about this airplane is that it was involved in a semi-mid air collision just over the runway at Santa Paula Airport on November 30, 1969. N741S landed on top of a C-170 just after it had landed. No one was injured but substantial damage was done to both aircraft. It is testimony to the toughness of Stardusters as N741S was flying again within four months of the accident.

Jack Swan owned this airplane for several years, and in the late 1970's or early 1980's I believe it was sold to Dennis Slavic of Crystal Bay Nevada, who also flew for Flying Tiger Air Freight. The airplane has set for many years and has just recently re-emerged. At the Tahoe Truckee Airshow in June of 91'. I looks as if it has been totally refurbished, recovered and repainted. To my knowledge it has attended no other fly-ins. Dennis is an interesting individual in that I have been trying to get information about his airplane for sometime. But so far none of my letters or calls have been answered. I'm not even sure the airplane has ever flown again, perhaps this article will stimulate him into supplying some current pictures an details. I only saw this airplane at Santa Paula in late 1969. It was then sporting the original Starduster paint scheme. It was something to see, and that is the story of N741S the only SA-300 RG.

David Baxter - Starduster History



Dennis Slavick's "mystery" Starduster is one-of-a-kind, with its retractable landing gear.

David C. Baxter
5725 S. W. McEwan Rd.
Lake Oswego, Oregon 97035

3/6/92

Dear Mr. Baxter,

Thank you for the information you sent us on the Starduster Too. It was greatly appreciated by all. The book you sent as a donation, "Starduster History," was of much help and interest. We look forward to learning about the total plane through your book, various pictures and guests, and our own construction of a Starduster.

You asked to learn more about our plane and the people involved. Our Starduster is currently in the sixth year of construction. To date, we have had a total of seventy-three students working on the plane over the years, along with our teacher, Mr. Richard Jablonski. The project has taken much time, turning inexperienced kids into aircraft builders in the matter of one to two years. We are hoping to complete the plane sometime in 1992. This is a goal we believe we can meet because of the dedication and diligence of those involved.

Many of our former Starduster builders have graduated to be very successful in the field of aviation. Many have chosen the areas of aeronautical engineering or flight study at major universities such as Embry-Riddle Aeronautical University. Others have gone on to various technical schools, including Harvard H. Ellis Tech, to become certified A&P mechanics. Still others have entered the military to work in the field of aviation, many of whom are in Navy or Air Force R.O.T.C. programs. Stephanie Dupen, who wrote to Starduster Corporation in 1986 has gone to Michigan State University with the original intentions of aeronautical engineering, but has left the field of aviation to pursue a career in elementary education. Troy Mox, who recently wrote to the Starduster Corporation, has gone to Embry-Riddle University in Florida to study airport management. From this year's class, we also have many students who will enter the field of aviation in one way or another. As you can see, today's young people are still just as interested as ever in aviation and aeronautical sciences. If you have any other questions, please do not hesitate to ask us.

Sincerely,

Aimee Sue Farland

Aimee S. Farland
Simsbury High School
34 Farms Village Rd.
Simsbury, CT 06070

TAXING SAFETY

A MOST TERRIFING EXPERIENCE

On Septemeber 30, 1989, little did Armin Holle realize that when he got up that morning how close he would come to it being his last. At Gillespie Airfield in Cajon California, Armin taxied N711MH out to the run up area. His thoughts were of the intended flight. Radio frequencys and check list ran through his mind. Apparently the run up area and the taxi way are close together. Unknown to Armin a friend of his in a Staggerwing Beechcraft had just let off some passengers at the terminal area and was taxing back.

As all tailwheel pilots know, tail down - nose up taxies are blind. It requires the pilot to be extremely cautious and the need to "S" turn while on the ground becomes of paramount importance.

Of course a Staggerwing with its 450hp Pratt & Whitney is even more blind. So you guessed it. The event that happened was a nightmare for everyone involved, including your insurance agent. The pilot taxing the Staggerwing taxied into N711MH, and all hell broke loose. The Staggerwing pilot shut the engine down with the propeller stopping just inches from Armin's head. The Staggerwing pilot and Armin were relieved. Armin because he was still alive and the other pilot because he hadn't killed him. The pilot turned out to be a good friend of Armin's.

This incident should serve to remind us that you can never be to careful while taxing around with the tail down.

D.C.B. Editor

STARDUSTER OPEN HOUSE - FLABOB AIRPORT 1992

Our trip to the annual Starduster Open House was as great as ever. Stops were Medford OR, Chico CA, Sacremento CA, Livermore CA, and San Carlos CA. The weather was good but the winds were not. We overnighted with Pam & Dennis Mayhew, and although they were unable to attend the Starduster Open House this year they were as usual wonderful hosts. Shortly after we were airborne from Chico the earthquake occured.

We then stopped at Sacremento Executive Airport to overnight with a good friend and business acquaintance Fred Sullivan. Then it was on to Livermore for a quick stop to see Les Homan and from there it was on to San Carlos to spend several days with our daughter and son-in-law, Debbie & David Rimerman.

The following Tuesday we flew to Concord to visit my old flight instructor Jane Lamar, who I had not seen in 25 years. We had a wonderful visit.

Thursday saw us back to Livermore to overnight with Les, so that we could get an early start Friday morning to meet up with all the southbound travelers at Tracy CA. As it turned out several of the airplanes that were supposed to go with us were unable to attend. The ones that did show up were: myself N96576, Les N4226Y, Pam & Charles McDermott N91672 in Starduster biplanes, and Mike Mattei flying Jess' Citabria. We then departed for Porterville. Wind, weather and visibility were good. Our stop at Porterville afforded us food, fuel, and reacquaintance with Harry Dellicker of Dell-Air. Harry is an I.A. with a repair and overhaul shop that specializes in unusual aircraft. He has also built several Stardusters and has worked on numerous others.

From Porterville it was past Bakersfield over the Tehatchapis, Lancaster and a quick stop at Hesperia as N9767Z had a much smaller fuel tank than Les or I. We felt it prudent before jumping over into Scud at Cajon Pass. From there it was over Rialto and in to Flabob. As it turned out there were several other early arrivals besides us, more than I have ever seen for a Friday.

This was also the weekend of the South Central Los Angles riots, and when I called Flight Service earlier in the day they were not recommending flight into the Los Angles Basin. We were however 50 miles to the east of all these crazy goings on. I talked to one of my friends who is based at Hawthorne and he told me the tower was closed, as well as several other facilities being evacuated and that they burned stores and gas stations at both ends of the airport. I am sure this is one of the main reasons why airplanes that normally attended didn't. We were however well represented by aircraft from: Salt Lake City UT, New Mexico and of course the Glue Angels from the San Diego area.

Friday evening saw most of us at Pinnacle Peak. Which is a cowboy steak restraunt that was across from our motel. You know the food has to be good when the menu is printed on a brown paper sack.

Full Scale Fokker D VII

N168C Acroduster One. Owned
by Harry Warr Riverside, CA.

Colin Corley - Sydney, Australia
Longest distance traveled.

There were about 60 people in our party so it took them a little while to seat us. We spent our time waiting in the bar/waiting room, and outside. While outside several very attractive ladies were also waiting to be seated, and Larry Rydberg along with most of the guys were admiring the paint jobs they were sporting.

An absolutely wonderful meal along with great new friends transpired that evening. A very interesting and colorful gentleman sat next to us that evening. His name was Ed Reinhorn, what a guy, he is reported to be the head Glue Angel as the rest of the San Diego bunch blamed him for everything.

Saturday morning saw us again at Flabob for picture taking, visiting and all the things that go along with this sort of event. Les Homan , Larry Rydberg, and Hank Schmeal gave numerous rides both Saturday and Sunday. There were about 30 Stardusters in attendance, along with a dozen or so other bilplanes. The most notable were two FULL scale World War One aircraft, a Spad and a Foker D VII. These are BIG airplanes. Food was again provided by Hank Schmeal and his crew. It was as usual wonderful. Prime rib, corn on the cob, salad, and strawberry shortcake. I don't know how he does it. He claims he'll never do it again, but he said that last year. Our undying thanks and sincere gratitude is pledged to him. Thanks Hank.

After the dinner awards were given.

BEST STARDUSTER

1st Place	N34LG	Glen Olsen	Salt Lake City, Utah
2nd Place	N847JT	Lance Murray	SanDiego, California
3rd Place	N78DS	David Silfast	Salt Lake City, Utah

SPECIAL AWARD

Most Unusual & Interesting Starduster - Ed Reinhorn Santee, California. (On the back cover of this issue)

ADDITIONAL AWARDS

Furthest Distance Flown - Dave Baxter N96576 Hillsboro, OR.

Hight Time Starduster Pilot - Les Homan N4226Y Livermore CA. with 1700 + hours.

Longest Distance Traveled to Attend Open House - Was won by Colin Corley of Sydney Australia.

Determination Award - Tom Murray N52U, His throttle linkage came loose and he had to stop and fix it. Oh by the way these airplanes won't go far at idle.

The 1st, 2nd, and 3rd place awards were hand carved wooden replicas of Stardusters mounted on a pedestal that had controls rigged up so that the aircraft could move about by control stick movement. They were well done and not cheap. Thanks Bill.

After the awards the place was cleared out and a live band played until very late. The people who did not dance continued to talk about their airplanes, and a great time was had by all.

Sunday saw a few more airplanes show up. We were late getting out of Flabob due to my tailwheel. Apparently my landing at Hesperia damaged the locking mechanism on my Scott tailwheel, and it took us a while to determine what the problem was.

1st Place N34LG

2nd Place N847JI

3rd Place N78DS

Thanks Bob Phillips and Peter Cavallo for their help. Our trip north took us to Santa Paula for a visit to Peter's homebase. We had N96576 my airplane, N4226Y Les Homan's and N2HC Peter Cavallo's.

We over flew the riot area well to the north and at 6,500 ft. saw little activity. Weather in the Burbank area and Van Nuys area was 15 miles + with scattered clouds. Which was much better than the 5 to 7 miles at Flabob Riverside that had plagued us during our stay.

While at Santa Paula my son Dan was treated to an aerobatics ride with Peter in N2HC. He flew his entire intermediate IAC routine, and this is something my son Dan Had been looking forward to for sometime.

After leaving Santa Paula for Livermore, it was down to Les and Myself. I did not realize how high we would have to fly to go over those mountains just north of Santa Paula. We had to go to 8,500 ft to get over them. Boy that yellow airplane of Les' sure is pretty in a climbing turn, just over the ridge line with the mountains in the background.

The rest of our trip home was uneventful with the same stops we made on our way down. After Livermore it was back to our daughter Debbie's in San Carlos for several days. From there it was to Nut Tree for a visit with Dick Waltermire and Patrick Fitzpatrick, both Starduster builders from Nut Tree. It was a short flight back to Chico Ranchero to overnight with the Mayhews. I do not know how I will ever repay them for there wonderful friendship, it is sincerely appreciated. Dennis also flew my airplane to see how it compared to his Starduster Too N6275. We also met Big Mike Kinslow, an ex-airshow pilot and aerobatics instructor, as well as Rick Thompson of Thompson Aviation at Orland Airport where Dennis is based. From Orland it was a short flight to Redding Sky Ranch to overnight with Pam & Charles McDermott our new found friends. Starduster people are wonderful, their children treated us like one of the family. A great chicken & steak B-B-Que took place in there backyard, which is right next to the Sacremento River.

The next morning we bid a sad farewell and with a fuel stop at Cottage Grove OR, we landed at Hillsboro OR our homebase Friday afternoon. Our trip was uneventful and N96576 had 31 more hours added to her flight time.

D.C.B. Editor

AIRPLANES IN ATTENDANCE - MAY 1992

SA-100	Starduster One	SA-700	Acroduster One
SA-300	Starduster Two	SA-750	Acroduster Too
SA-500	Starlet		

N96576	SA-300	Dave Baxter
N99DB	SA-300	Dick Heath
N5317Q	SA-300	Bob Phillips
N81582	SA-300	Jeff Eisenbeiser
N2HC	SA-300	Peter Cavallo
N292EP	SA-300	Fred Wooldridge
N73866	SA-100	John Alling
N519B	SA-750	Bob Bonde
N7805	SA-300	David Silfast
N63BR	SA-100	Bob McCall
NN34LG	SA-750	Glen Olsen
N530LR	SA-300	Larry Rydberg
N4226Y	SA-300	Les Homan
N108	SA-300	Scott Marshall
N52U	SA-300	Bob Norcutt
N847JT	SA-300	Tom Murray
N107JC	SA-300	Ed Reinhorn
N24LP	SA-300	Bill Payne
N1300S	SA-300	Jack Winer
N186C	SA-700	Harry Warr
N711MN	SA-300	Armin Holle
N9167Z	SA-100	Charles McDermott
N8331A	SA-300	John Renquist
N1468	SA-300	Lee Dorance
N7139	SA-500	Phil Friar
N27CG	SA-300	Bill Wyse

Search-and-rescue officials ask: Mind your ELTs

Search-and-rescue volunteers strongly recommend that you not crash your plane in the wilderness this summer.

Just in case, though, they have some tips that could help rescuers find you.

"The biggest help a pilot can give us is to file accurate flight plans and make detailed and periodic position reports," said Brian Holmes, search-and-rescue coordinator for the Washington State Division of Aeronautics.

You should also make sure that your ELT works, of course. But don't bet your life on it.

"ELTs have saved some lives," said Holmes, "but they are not as effective as we all think they are." Nationwide in 1990, he reported, ELTs only worked in 25% of off-airport landings.

In fact, ELTs often seem to work better *on* airports, a situation that causes headaches for search-and-rescue volunteers

In California alone, Search-and-Rescue Coordinator Kenneth Jordan said in 1990 more than 5,000 ELT signals were tracked to airplanes parked at airports.

Nationwide that year, the Air Force Rescue Coordination Center said more than 2,000 of the 3,000 missions it mounted were in response to stray ELT signals.

Despite the wild goose chases, however, search-and-rescue experts urge pilots to make sure their ELT batteries are working.

Other suggestions to ensure your survival:

- Always carry an emergency kit on board your plane.
- Stick with your flight plan.
- If your plane does go down, stay with it, and do everything possible to make it more visible.

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TECHNICAL BULLETIN 92-2 **MAY, 1992**

REFINISHING DOPE & ENAMEL

COATING AND FABRIC IDENTIFICATION

Before trying to refinish aircraft fabric, the type of coating(s) and fabric installed on the aircraft should be determined and a decision made as to whether it is economically feasible to refinish the fabric, based on the condition and type of coating(s) and finish, and the remaining expected service life of the fabric. The same type fabric may not be installed on all components and components may have been recovered at different times.

Cotton fabric meeting TSO C-15 or TSO C-14 can be identified by the off white color and thread count of 80 to 94 for TSO C-14 and 80 to 84 for TSO C-15 in both directions.

Aircraft linen conforming to British spec. 7F1 may be identified by a slightly darker shade than cotton fabric and irregular thread spacing. The average thread count will be about the same as Grade A fabric (TSO C-15). The non-uniformity of the linen thread size is also noticeable, with one thread half the size of the adjacent thread.

When viewed under a magnifying glass the ends of the cotton and linen fiber nap may be seen on the backside. The nap is also seen when the coating is removed from the front or outside surface.

Glass fabric can range from a coarse weave 34x36 (Razorback) to 60x58 threads per inch (Airfiber). Glass fiber is a monofilament and there will be no filament ends showing unless fibers are broken or sheared due to impact by a sharp object such as a rock, or the filaments have been broken by abrasion.

Polyester fabric, a mono-filament with no nap, is whiter than cotton, and styles used for aircraft covering have a thread count ranging from 54 to 150 per inch.

Another method of determining the type of fabric, when small samples can be removed from the aircraft, is a burn test. Cotton and linen fabric, when stripped of all coatings, will burn leaving a dry ash. Polyester burns after melting to a liquid. Glass fiber does not support combustion and will become white hot over a flame.

FABRIC COATING PROBLEMS

Aircraft covered with polyester fabric and coated with a nitrate and butyrate dope system, regardless of the dope brand or type of finish, account for the majority of the several dozen requests we receive each month for advice in repairing, reworking, refinishing and solving aircraft fabric problems. It is often noted that the suppliers of the polyester fabric and dope covering systems and the dope and auto enamel manufacturers do not provide instructions to rework their peeling and cracking problems and their former customers come to us for help.

The so-called non-tauting nitrate and butyrate dopes contain an excess amount of plasticizer which only delays the full tauting characteristics until the plasticizers have migrated over a period of 6 months to 2 years, depending on the exposure conditions. Mil specifications are a military purchasing agent acceptance standard. There is no civilian counterpart to test and endorse a cellulose dope product as meeting a Mil Spec. Therefore, there are no actual Mil Spec dopes on the market and there were never Mil Spec formulas for so called non-tauting dope.

All Mil Specs for nitrate dope were long ago placed on the inactive lists and the CAB ester to manufacture Mil Spec butyrate dope is no longer available to any coating manufacturer.

Epoxy primer, automotive lacquer primer and automotive metal finishes, including urethanes, should never be used on any fabric surface.

If the aircraft is kept hangared and flown only to an occasional air show for a roped off static display, any type of sub-coating and finish will appear to be satisfactory. It is not unusual for "hands off" display aircraft to go two, three, or five years without accumulating large cracks, except in areas inadvertently flexed beyond the automotive coating limits around the cockpit or wing walk.

A thick heavy coating buildup which hides all tape edges and fabric weave, is a negative factor and only shows a **lot of money** was spent on **unnecessary materials** and **many extra hours labor,** to add a lot of **extra weight** to the airplane. Very often, thick **heavy coatings hide very poor fabric workmanship.**

Good workmanship is indicated by straight finishing tapes and all tape and reinforcing patch edges laying down with no cutting or notching the tapes to conform to the surface, rib lacing alignment, uniform application of all coatings with no runs or orange peel, no sandpaper damage, clean sharp edges on trim lines and "N" numbers, and proper fabric tension throughout.

Most owners do not become concerned about the cracks and peeling problems until a year or two after they first appear and have multiplied and start to generate comments from other persons. A very close inspection of all fabric covered aircraft at a fly-in or airshow, or tied down at small airports is very enlightening. It is noticed many former trophy winners with exotic paint schemes using automotive finishes are left hidden in the hangar after the second year, due to cracks.

PRINCIPLES OF REJUVENATION

Any coating that cannot be dissolved with MEK cannot be successfully rejuvenated to restore the needed flexibility and avoid further cracking. When fabric is finished with a non-soluable coating and the cracking and checking is severe, it is usually more economical to completely recover than try to carefully strip the insoluble coating off with a paint stripper without damaging the underlying softened coatings in order to rejuvenate and refinish. Stripping small areas is economically feasible, but stripping entire wing panels usually results in a botched refinish when the solvent softened underlying film is gouged with a tool. Further, the solvents in the paint stripper often loosen the finishing tapes and overlapped dope or cemented fabric splices, which are under tension. The most effective stripper to be used on the insoluble coatings on both fabric and metal contains methylene chloride, a very penetrating chlorinated hydrocarbon.

Nitrocellulose resin and cellulose acetate butyrate ester resin (C.A.B.) are processed from wood fiber and cotton linter and have compatible modifiers, known as plasticizers, added to impart a degree of flexibility necessary for extended service life on fabric. There are many types of plasticizers that may be used in nitrocellulose resin because it is more compatible with many types of modifers. Mil specifications for nitrate and butyrate dope define the quantity range and the quality of each material, however at this time there are no mil. spec. aircraft dopes on the market and each manufacturer has his own formula to compete.

Castor oil and tricresyl phosphate are two plasticizers used in nitrate dope. Tricresyl phosphate and triphenol phosphate are used in butyrate dope. These plasticizers will migrate with age and high temperature, and disappear from the dope film. Migration of the plasticizers causes tension to increase, therefore the increased tension coupled with the less flexibility will result in cracks when dope film is bent beyond its flexing limits. Ringworms are caused by impact load in a concentrated area, which in effect is a circular crack.

A good dope rejuvenator consists of a mixture of clear dope, plasticizers, and a blend of strong penetrating solvents and slow evaporating solvents. The theory of rejuvenation is to penetrate and soften the old film with the solvents which carry the new plasticizers down into the softened film before the solvents evaporate. During rejuvenation the film is very soft and easily damaged. Therefore rejuvenator should be applied with a spray gun, not by brush which may disturb the soft film on the second and later coats. Rejuvenation should take place in weather conditions which will permit slow drying rather than solvent flash off before the solvents have the opportunity to penetrate properly. Two to four spray coats at 10-15 minute intervals are usually required.

When rejuvenator is used on any fabric which was tauted by the action of the shrinking dope film, the fabric will slacken and remain slack until the solvents have evaporated. These fabric types include cotton, linen, and glass fabric. Slacking does not occur on polyester fabric, a thermoplastic which was tauted by heat.

When nitrate or butyrate dope coatings have long cracks the cracks will open about three times their original width as the rejuvenated and softened dope film begins to dry and taut. Small ringworms and short checks will open only slightly due to the continuity of the surrounding film. Heavily checked and cracked dope finishes therefore are never refinished to the original new appearance, due to the necessity of filling in the widened cracks and trying to sand to get a smooth appearance. Heavy finish coats also resoften the dope film and open the cracks wider. The crack repairs will invariably show through when the finish is completed.

The crack widening problem seems to be more noticeable with nitrate and butyrate dope on polyester and butyrate on glass fabric which do not provide as good a bond for the dope coatings as cotton and linen. Therefore, the degree of cracking should be a consideration when determining whether to refinish or recover, or strip to bare fabric and start a new dope film buildup. A small test area or component is recommended for experience.

REFINISHING NITRATE AND BUTYRATE DOPE ON COTTON OR LINEN FABRIC

Very rarely is nitrate dope used as a finish, particularly in view of the better durability of butyrate dope finishes and the fact that pigmented nitrate dope is no longer readily available, due to its decreasing demand. We recommend that nitrate dope coated surfaces be patched with butyrate dope when necessary, rejuvenated with butyrate rejuvenator, and finished with butyrate dope if dope finish is used, rather than going back to nitrate dope. Do not use nitrate dope over butyrate dope because butyrate dope is not compatible when overcoated with nitrate dope and the butyrate dope underlying film will check in a short length of time. Naptha is used in nitrate dope and will cause butyrate dope to kick out of solution when the two are mixed. Therefore, a simple test to determine dope type is to add a spoonful of naptha or nitrate dope or lacquer thinner to a spoonful of test dope. Incompatibility will indicate butyrate dope. Butyrate dope thinner is compatible in nitrate dope. Therefore, butyrate over nitrate — not nitrate over butyrate.

When an incompatible coating, solvent, or rejuvenator has been put on butyrate dope many small checks, some appearing as scratches in the surface will be noticed when viewed at about a 45 degree angle to the surface to catch the reflection from a light source.

Dope on cotton and linen is rejuvenated in the following procedure:

REJUVENATING PROCEDURES

1. Remove any visible oil and grease from the fabric surfaces with C-2210 Paint Surface Cleaner. Use a clean cotton cloth for a final wipe. Shop towels furnished by towel rental services may be contaminated with silicone, which transfers to the surface being cleaned with the solvent. Use new untreated, knit type, lint free polishing cloths available from most automotive supply stores, or equivalent paper wipe towels.

2. Wash the surface with 1 part 310 Cleaner to 20 parts clean water to remove all dirt, loose oxidation, oil film, silicone, and wax from old polish.

3. Wet sand the surface with 280 grit Wetordry sandpaper and wash the residue off with clean water and dry with clean rags.

4. Apply 2 to 4 coats of a good quality butyrate dope rejuvenator on nitrate and butyrate dope finishes. Thorough penetration and softening of the dope film is important. Avoid rejuvenating in temperatures above 80° or in direct sunlight, due to rapid evaporation of the solvents.

5. After the rejuvenated surfaces have dried to a firm film (2 or 3 days) 2 coats of good quality aluminum pigmented butyrate dope may be applied. If small cracks in the old finish are visible after the butyrate dope coat has dried, they may be sealed with aluminum butyrate dope using a small soft brush. Applying additional coats of aluminum butyrate dope and sanding with 400 grit Wetordry (3M) paper after each coat has dried is optional, and will depend on the surface condition and cracks being covered. Coarse sandpaper used near the final finish coats leaves scratches that will telegraph through the finish film.

6. Pigmented butyrate dope finish may be applied as soon as the aluminum butyrate coats have dried a few hours and no later than 3 weeks. The mil spec formula for clear butyrate dope calls for approximately 10% of the non-volatile content to be plasticizer. The plasticizer percentage of the non-volatile content of mil spec pigmented finishes ranges from 20 to 32% depending on the color. The lower plasticizer content of clear and aluminum pigmented butyrate dope coatings is not sufficient to avoid checking when recoating after drying 3 or 4 weeks due to dissimilarity in the tension between the top and bottom of the dope film. Therefore, dope coatings should always be completed through the color coats without long delays or rejuvenated to relieve the dissimilarity in the tension before finishing. The formulas used for the better quality dope brands are based on mil. spec. formulas.

A common cause for poor adhesion of any coating on aluminum pigmented nitrate or butyrate dope is an excessive amount of aluminum pigment added to the clear dope when mixing in the field. If the aluminum pigment can be easily transferred to the finger when rubbing the surface, the proportion of aluminum pigment to dope is too great. The sur-

face should be sanded to remove the excessive pigmented aluminum dope film and recoated before finishing, or the new finish coats will peel off with masking tape after trim colors are sprayed and when flying in rain. 3½ oz. aluminum paste per gallon unthinned dope is about maximum. The mil spec and other recommendations for larger ratio up to 8 oz. per gallon are for finish coat aluminum pigmented dope, not undercoats.

REFINISHING NITRATE AND BUTYRATE DOPE ON POLYESTER FABRIC

It has been our experience that trying to refinish a cracking dope coating on polyester is a waste of labor and materials. Rejuvenating the taut cracked finish will restore the flexibility, but not improve the adhesion and when the rejuvenated dope coating dries in a few days the cracks will widen even further. Repeat the rejuvenation and the cracks soon become 1/4 inch wide. Patching and refinishing is only a temporary measure. Dry stripping the entire coating to the fabric if the fabric is still airworthy is the most practical solution, short of recovering.

If the cracked and brittle nitrate and butyrate coatings will dry strip to the bare polyester fabric, or can be easily removed by scraping with a dull blade after softening with 50/50 butyrate retarder and MEK or just MEK, the buildup procedure will be the same as starting from new fabric.

When the backside of the fabric is accessible MEK applied with a brush or engine wash gun will help release any solvent soluble coating system.

Directing a high pressure water jet, or if wood structure are involved, high pressure air jet, at an angle at a break in the coating has been found to be effective in stripping poor bonding coatings. When a structure is all metal with no possible damage to wood components, a high pressure water jet directed on the fabric backside will in many cases remove coatings from polyester fabric.

Any old dope film remaining on fabric surface after stripping should be removed by scrubbing with MEK.

Before starting to recoat stripped fabric with Poly-Brush the fabric should be tauted to the maximum capability with an iron calibrated at 350° F. because Poly-Fiber coatings are nontauting and will not increase the tension the same as the original nitrate and butyrate dope film. Otherwise the finished fabric can be expected to be loose in cold weather.

Use a cotton cloth over the hot iron to lessen the possibility of igniting any nitrate dope remaining in the fabric weave. The first coat of Poly-Brush should be reduced 50% to provide good penetration through the partially blocked weave.

If repair, patching and refinishing the dope coating is decided to extend the service life and delay the recovering, the following procedures are suggested.

Adhesion of the old dope coatings should be spot checked with a strip of masking tape pulled off rapidly at 90 degrees. All loose sections should be stripped off. Loose or deteriorated finishing tapes and reinforcing and inspection accessories are replaced or repaired.

REFINISHING COATINGS INTERMIXED WITH POLY-FIBER MATERIAL

Heavy coats of pigmented butyrate dope finish applied (contrary to our advice) over Poly-Fiber covering materials, which have checked and cracked due to excessive surface tension, will continue to shrink and open new cracks in the softened film when rejuvenating and refinishing. Solution: Sand off all the butyrate dope finish or strip all coatings or re-cover.

We have never received a report of Poly-Fiber coatings finished with Poly-Tone developing ringworms. However, we do receive reports of coatings erroneously presumed to be exclusively the Poly-Fiber system developing ringworms and peeling. When we examine samples and test, with no exception we find there is an intermix of nitrate or butyrate dope or acrylic lacquer or automotive lacquer primer between or under our coatings.

Aircraft owners who purchase an aircraft after being recovered are often confused about the type and source of fabric and coatings on the aircraft. Log books and old Forms 337 very often do not reveal all the facts of a coating buildup and the new owner or mechanic cannot rely on a log book for accurate information on the identity and source of the fabric and coatings.

We can assure the mechanic there is an intermix of nitrate or butyrate dope, acrylic lacquer, or automotive lacquer primer with our coatings when hard thumb pressure in the center of a panel ringworms and cracks, instead of stretching and leaving a temporary depression. The intermix of coatings assures a poor bond which can be dry stripped down to the last coat that provides a satisfactory bond to the sub-layer.

Any incompatible coating should be stripped from the fabric and built up with new coatings, as suggested for refinishing nitrate and butyrate dope on polyester fabric.

If the coatings tend to crack, but are still firm and intact with very few cracks but good adhesion and the top coat is Poly-Tone finish, there is no reason to incur the immediate expense of stripping or re-covering. We recommend refinishing as if it were a Poly-Fiber coating all the way through, to restore some degree of flexibility and extend the service life as long as possible. Log books should record the refinish materials and fabric condition, to assist the next mechanic.

REFINISHING SYNTHETIC ENAMEL, ACRYLIC ENAMEL, EPOXY ENAMEL AND AUTOMOTIVE URETHANE ENAMEL

There is no cure-all coating to repair the cracks, restore the needed flexibility, and prevent further cracking and peeling. Any new top coat is only as good as the sub-coats. Refinish should be considered only a temporary fix to postpone recovering.

If the underlying dope film on the fabric is to be rejuvenated, the enamel must be removed.

A decision should be made whether the remaining service life of the fabric would warrant the expense of stripping, rejuvenating, and refinishing. It is not economically feasible to strip large areas. Final appearance of a reworked surface should be considered.

If stripping is decided, #5 Paint Stripper is recommended, working small areas. As soon as the enamel surface has wrinkled and released, wash off and neutralize with a high pressure water jet to avoid stripper solvent penetrating the underlying dope film. Thoroughly clean and sand the nitrate dope, or butyrate dope surface after all stripper solvents have dissipated and refinish as recommended for these coatings.

Do not use paint strippers containing paraffin on fabric. The paraffin may penetrate the coating and fabric weave and prevent adhesion of the new coatings. Good strippers use special wax, not paraffin, to form a film on the stripper surface and prevent the methylene chloride from evaporating rapidly.

If the fabric tests satisfactory, the dope film is sound, and the enamel finish is sound (no cracks) but faded and chalking, it may be refinished with enamel.

A thorough washing and sanding as outlined in steps **1.** through **3.** is recommended, followed with the new finish before the surface becomes contaminated from handling or weather.

REFINISHING NITRATE OR BUTYRATE DOPE ON GLASS FABRIC

The single layer glass fabric and dope covering systems are probably the least understood of all material combinations.

The theory of thorougly penetrating the fabric weave of cotton and linen for better dope bond is not applicable to glass fabric. Unthinned dope is sprayed, not brushed, to deposit only on the outer surface of glass fabric to form a solid film after repeated applications to avoid penetration and bonding the weave together. A solid film of nitrate or butyrate dope on any woven material will shrink and tend to pull the host surface with it. In viewing the backside of glass fabric panels under a magnifying glass, it will be noticed that the excess filament length is absorbed by the glass fiber thread pushing back from its contact with the mating cross thread lying nearest the doped surface. The gap or distance depends on the amount of filament length to be absorbed.

The total panel shrinking is limited to the ability of the yarn to bend at each thread crossing and absorb the excess length. Sometimes sections up to 1/4" diameter or long wrinkles will fold back from the dope film to accommodate the strong tauting action. Therefore coarse glass fabric styles are more suitable, but require considerably more dope to fill and build to an acceptable smooth surface. If the glass fabric is installed too tight by hand before doping, the thick heavy dope film needed to fill the weave will warp and damage the structure within a few months.

The durability of glass fibers has been grossly overstated in glass fiber sales literature for many years, and this erroneous information is picked up and repeated in many books and manuals.

Example: AC 65.15A, copied by many authors as fact, states on pages 88 and 105, *"glass fiber is not affected by moisture, mildew, chemicals or most acids."*

There are five manufacturers of glass filament in the United States and their chemists are knowledgeable of the expected performance in each particular application. The misleading statements that glass filaments are not affected by moisture, chemicals, acids, or alkali appear in sales promotion literature printed by some of the large mills that weave the glass filaments into cloth for industrial applications. These claims are based on the unstated assumption the glass filaments will be encapsulated in some form of matrix, such as epoxy or polyester, to protect the filaments.

Our tests with an industrial glass fabric sold under the tradename "Razorback" for covering aircraft show that a 100 hour soak in room temperature tap water reduced the strength of the glass fabric 27.2%. One year exposure of the unprotected glass fabric on a 45 degree incline south facing test fence at Riverside, California, reduced the strength from 170.4 lbs. to 39.4 lbs., a 76.9% loss in strength. REF: *Test Reports,* Chapter 5, Poly-Fiber Manual, Revision 14 and later issues.

Before wasting time and material attempting to rejuvenate and refinish a badly checked and cracked butyrate dope coating on glass fabric a close examination should be made of all long cracks in critical areas which may have exposed the glass filaments to the weather and pollution fall-out for 6 months or longer. Firm finger pressure over the cracks will reveal any weak or deteriorated areas.

All glass rib lacing should be checked for failure by pulling the fabric surface with a suitable vacuum cup (plumbers helper). Glass rib lacing cord failure is the subject of an FAA AD note and mentioned in AC 43. 13-1A, Chapter 3, Section 4. Ballooning fabric from failed or cut rib lacing can cause an accident.

All surfaces in the prop wash area should be checked for abrasion cut at all structure contact. We receive reports from customers who have removed glass fabric and find only the finishing tapes over ribs and stringers were holding the fabric in place after being chafed completely through along the edges of ribs and stringers, as if cut by a knife from the inside.

If the dope film is in fair condition with only few minor cracks, follow all testing, cleaning, and rejuvenating procedures outlined for nitrate and butyrate dope in steps **1.** through **6.** Any nonsoluble finish such as enamel, epoxy, or urethane coating, must be removed before the underlying dope film can be rejuvenated. Stripping large areas is not practical.

Any repairs such as replacement of tapes, should be made with butyrate dope using glass fabric and finishing tapes of a quality equal to the original material. All dope coatings on new fabric patches covering holes must be sprayed at high viscosity to avoid penetration as stated earlier. Tapes should be brushed lightly to avoid distorting the glass threads.

REFINISHING WATER BORNE COATINGS ON POLYESTER FABRIC

Various water borne acrylic latex coatings similar to house paint such as Super Shield, Eonnex and the Ceconite 7600 system (Eonnex 7600 acrylic latex on Ceconite fabric) have been used on polyester as a base coat and finished with solvent system top coats (color). Brittleness and cracks can be expected within 2 years when stored unprotected in the southwestern U.S.

Acrylic water borne coatings cannot be rejuvenated in the same manner as solvent system coatings and recovering is the logical solution to a badly checked and deteriorated covering.

REFINISHING EPOXY/URETHANE COATING SYSTEMS

Coatings systems such as Cooper Superflite Durethane using Ditzier automotive coatings become brittle and loose adhesion to the fabric after aging.

In some cases the complete epoxy-polyurethane coating can be dry stripped from the fabric surface by using a dull putty knife. If it cannot be dry stripped, the only logical remedy to cracking problems is to recover. Any attempt to refinish over existing cracks is a waste of time and money.

REFINISHING SUGGESTIONS SUMMARY

Success in rejuvenating and refinishing old surfaces will depend on their condition, the compatibility and adhesion of the various type coatings throughout the buildup and to the fabric, and the experience and skill of the mechanic performing the operation. A small component such as elevator or aileron should be refinished completely through all stages to determine if the results and adhesion are satisfactory before undertaking the complete aircraft.

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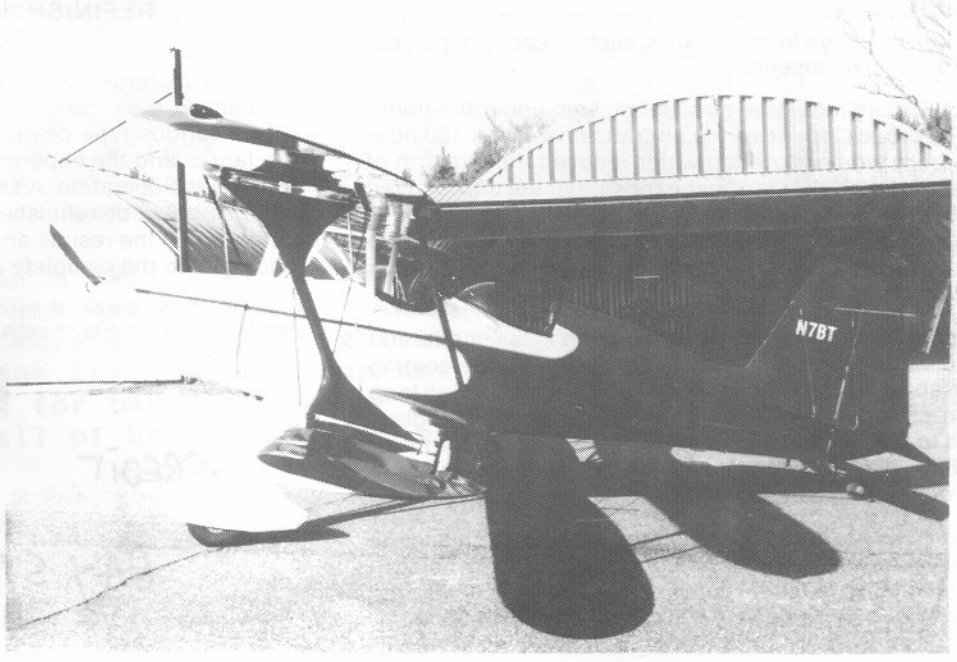

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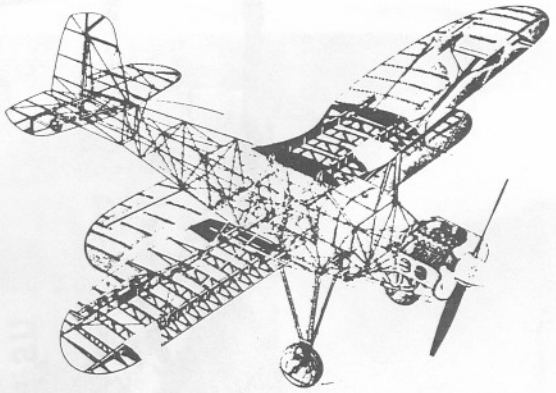

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