Falco Construction Note 61005-1

Cowling, Baffling & Nose Gear Door Installation

This Falco Construction Note replaces Advanced Builder Memo "Chapter 42 Cowling, Baffling and Nose Gear Door Installation"

Introduction

If you wish, you may install the baffling first, but we suggest that you install the cowling first. By our calculations, the baffling will come very close the the cowling doors. Thus, you will need to install a blister for the right front cylinder for the 150-160 hp engines and will need a blister for both the right and left front cylinders for the 180 hp engines. The presence of the baffling will interfere with the installation of the cowling, so we suggest that it be installed after the cowling. If the baffling is already fitted, then we suggest that it be removed during the installation of the cowling.

Cowling Supports Installation

The first step is to install the cowling supports on fuselage frame No. 1. The details for this are shown on the new (as yet unfinished) showing the details of fuselage frame No. 1 and the equipment installed on it.

You will have to allow for the thickness of the cowling (approximately .100") when locating the cowling supports. Also, you should note the position of the screws which are installed through the cowling supports. These screws should be located so that the cowling supports may be removed. It may not be obvious to you at this time, but the nutplates for the cowling could keep you from getting a screwdriver to the screws. Locate the position of the nutplates first, then locate the screws. (Flush screws are not a good idea with fiberglass.)

The cowling supports are supplied overly long. The locations for trimming are marked on the supports. You will have to trim the two side supports to fit around P/N 720 engine mount lugs.

One builder reported that the bend of the cowling supports at the 10:00 and 2:00 position was not quite tight enough. He did a sawcut into the flange of the cowling support and was able to get it to the correct bend. We have checked the cowling supports we have here, and we don't see the problem. Other builders who have installed the cowling agree with us.

Note that the cowling supports share the bolts for the front fuel tank hangars. This will require that you remove the front fuel tank to install the cowling supports. One builder skirted this issue by cutting the supports off short of the bolts. We don't think there is any harm in that. The cowling is relatively light, and during flight the cowling will be pushed toward the firewall by the force of the air.

Cowling Jig Installation

The next step will be to install the cowling jig. See Drawing No. 134, Section A-A for this. Please be careful to keep the hardware for the cowling jig separate as it must all be returned with the cowling jig.

Hang a 50 lb. weight from the extension on the cowling jig to simulate the weight of the propeller. It is best if your engine has been installed on the engine mount for a couple of months, during which time the engine will have settled slightly. The engine will not move very much when you hang the weight on the jig, but it only seems to make sense to do this.

When you install the lower cowling, you will find that you will have to loosen the cowling jig to remove the lower cowling. The reason for this is that the starter interferes with the cowling. The solution is to remove the starter for the cowling installation.

Lower Cowling Installation

To strengthen the cowling during shipment, the opening for the nose gear has not been cut. Later, we will be shipping the nose

gear door kit. The door for the nose gear will be the same shape that you have on the cowling, so you might want to make a mold from the cowling if you are in a hurry.

If you wish you may use the part that you cut out as the nose gear door. The door will be installed so that it overlaps the cowling. This will mean that you will have to add fiberglass to the door or to the cowling. It is not critical when you cut the nose gear opening. Some builders have found it most convenient to install the cowling with the nose gear retracted. Using this method, the lower cowling is substantially stiffer and easier to install.

If you are working alone, you will find that the lower cowling can be supported by placing a board across the engine or engine mount and supporting the cowling with nylon straps wrapped beneath the "belly" of the cowling.

You should proceed with some caution on cutting out the opening for the nose gear. The cowling is supplied with extra length at the aft end, so this could throw your measurements off if you do not take this into account. The basic dimensions are shown in the sketch below.

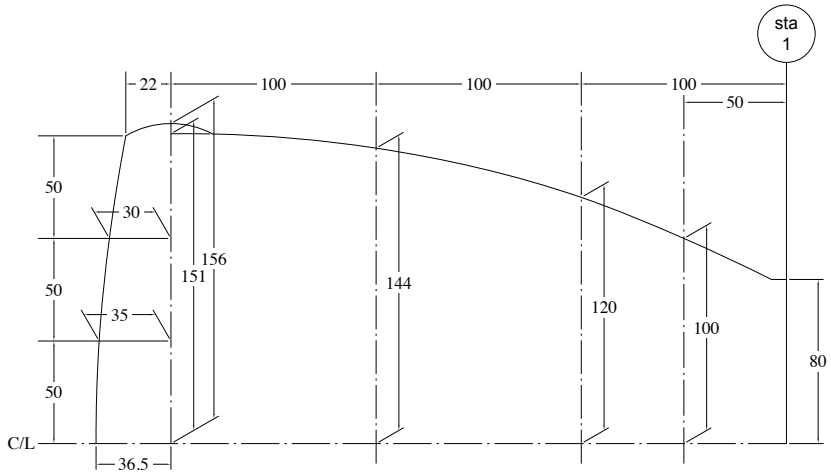

Figure 1. Nose gear opening

At this time, you only need to trim the opening sufficient for the clearance for the nose gear. The final trimming, particularly at the forward end, should be done when the nose gear door is fitted.

You should be careful to get the cowling level. Note from the cowling installation drawing that the bottom of the cowling access doors is at W.L. –170. This is for the bottom of the door, *not* for the top of the joggled portion of the bottom cowling.

Clamp the lower cowling to the jig and trim the cowling as necessary to fit the firewall. The cowling is intentionally supplied overly long at the aft end for this purpose.

Drill the holes for the installation screws that are installed through the cowling supports.

> *Note*. For the No. 8 screws you should use a #19 drill (.166"Ø). Be very careful when drilling through the fiberglass and aluminum. The drill bit could easily wander on you when it starts to drill through the aluminum. There are several ways to drill such a hole. One way is to drill the hole in the aluminum and then drill with an angle drill through the fiberglass. This way, there is no problem with the drill wandering on you.

If you cannot use an angle drill, then you would be better off to drill the hole initially with a sharp #40 drill, then ream up to the final size.

Whatever method you use, you should be careful to install clecos or screws in each hole to make sure that the cowling does not move on you while you are drilling the next hole.

Remove the lower cowling and install the MS21047-08 nutplates on the cowling supports.

Upper Cowling Installation

With the lower cowling installed on the cowling supports, clamp the upper cowling in position. It is best if the lower cowling remain in position during this operation to insure that the upper cowling is also level and will match the lower cowling.

Trim the aft end of the upper cowling to match the firewall. The upper cowling is supplied overly long at the aft end for this purpose.

Drill the holes for the nine screws that attach the upper cowling to the cowling support on the firewall. See note above on drilling through fiberglass and aluminum.

Remove the upper cowling and install the MS21047-08 nutplates on the cowling support.

Put the upper cowling back on and check the fit at the forward end. Adjust or sand as necessary for a good fit.

Drill the holes through the upper and lower cowling for the ten screws which join the two parts at the forward end.

Remove the cowling parts and install the MS21047-08 nutplates on the lower cowling. You may have to bend the tangs of the nutplates slightly to get them to fit.

> *Note*. The rivets for the nutplates are soft MS20426A3-5 rivets. Using hard "AD" alloy rivets will crack the fiberglass.

Cowling Door Installation

Replace the upper and lower cowlings on the airplane, with the cowling jig still in place.

The cowling doors are supplied overly long for trimming. In addition, the doors are slightly too long at the bottom and all trimming should be at the bottom. Move the door forward and aft and decide whether you want to trim the forward or aft end of the door. Because of the shape of the door, you could do some final trimming on either end. As it was made, the door is trimmed (so recalls the fabricator) so that the aft end of the door was at the "net" trimmed angle, so that all trimming should be done at the forward end. Don't accept this at face value, check this on your cowling and trim for the best fit.

> *Note*. To insure a good fit for the cowling doors, the following assembly order is suggested.

1. Drill or punch the holes in the hinge with a #40 drill or 3/32"Ø punch.

2. Clamp the hinge in position and drill through the upper cowling. Check to make sure that the door will be allowed to open without binding the door with the upper cowling. On many of the upper cowlings, the thickness of the upper cowling is slightly greater at the forward end of the hinge. This extra thickness must be removed before the hinge is installed. (On Dave Aronson's Falco, this was not done. As a result, the paint at the forward end has become chipped when the door is opened.)

3. Remove the hinge and drill or punch the holes in the hinge support angle, P/N 840-16.

4. Cleco the hinge and support angle on the upper cowling and ream the holes up to 1/8"Ø.

5. With the hinge pin installed, position the cowling door so that there will be some material that can be trimmed on both the forward and aft ends of the door. Mark the locations of the ends of the hinge.

6. Remove the hinge pin and clamp the door half of the hinge to the door. Drill through the cowling door in two places using a #40 drill or 3/32"Ø drill. Install 3/32" clecos.

7. Check the fit of the door by installing the hinge pin. Because the existing holes are small, some minor adjustment may be made by moving the door on the hinge and drilling new holes. The mis-aligned holes can be easily reamed up later.

8. When you are sure that you have the hinge in the proper location, proceed by drilling all of the remaining holes in the cowling door, then ream up to 1/8"Ø.

9. Bond the hinge and support angle to the upper cowling. Bond the hinge to the cowling door. Do not trim the cowling door at this time. Proceed according the the instructions below. Be sure to remove any paint on the inside of the cowling.

10. Install the rivets for the cowling hinge after the epoxy has cured for 24 hours.

11. Install the cowling doors by inserting the hinge pins.

12. Trim the cowling door at the forward and aft ends to match the cowling. Then trim the cowling at the bottom end to match the joggled portion of the lower cowling.

See the cowling installation drawing for the details for the hinge installation. It is probably easiest to punch or drill the 1/8"Ø holes in the hinge first and then drill through the cowling with an angle drill, if available. If you don't have an angle drill, then you will have to remove the upper cowling and drill the holes from below. It is normally a good practice to drill all holes with a #40 drill and use 3/32" clecos and then do a final ream up with a 1/8" drill and install 1/8" clecos. Just before the rivets are installed, you should ream up with a #30 (.128"Ø) drill.

We suggest that you install the hinge on the upper cowling first and then install the hinge on the cowling door. A set of clecos would appear to be indispensable, but some builders use No. 6 screws in their place. After drilling the holes in the upper cowling, drill the holes for the cowling hinge support angle, P/N 840/16. See Section E-E. The easiest way to do this is to remove the cowling hinge from the airplane and clamp the angle in place. Use a drill or punch to match the holes in the hinge. After all of the holes are drilled in the angle, put the hinge and angle back on the upper cowling with clecos.

To drill the holes in the cowling door, it appears that the only way is to hold the door in position, while an assistant uses an angle drill to drill through the cowling door by reaching across from the other side. Once a few holes are drilled in the door, the door may be swung open, and the remainder of the holes drilled from the bottom.

The hinge may be installed on the upper cowling and cowling doors with either universal or flush rivets. Both types of rivets are supplied in the kit, so take your choice. Note that the hinge is also bonded in place with epoxy. The proper epoxy, 3M 2216B/A, is supplied in the kit as P/N 840-22 epoxy kit. Note also that the rivets that are used for the installation of the hinge are soft "A" alloy rivets. The use of hard "AD" alloy rivets will cause the fiberglass to crack.

The specifications for the epoxy specify a clamping pressure of 10 psi. If you rivet the hinges at the same time that the epoxy is curing, the clamping pressures will be excessive and some glue starvation may result, although the rough surface of the inside of the cowling may keep this from happening. In addition, if you plan to use the flush rivets the countersunk hole will not be good enough for good alignment. The pressures created by the riveting will cause the fiberglass to have a scalloped appearance, if riveted while the epoxy is curing.

As a result, it is best to bond the hinges in place and *then* rivet after the epoxy is cured. The optimum cure temperature is 75° F and the optimum cure is 7 days, although the rivets may be driven after 24 hours. Before bonding the hinges, all parts should be wiped with MEK or lacquer thinner. The bonding of metal parts is not as easy as it sounds and requires some high technology cleaning. Although the epoxy supplied is one of the best for this purpose, the cleaning procedures are not optimum. As a result, you should consider that you have only a "fair" category epoxy bond. For that reason, rivets are use just to make sure. Rivets alone would do the job, but it is far superior to use both epoxy and rivets.

We suggest that you bond the hinges in place by using clecos. Spray a little WD40 on the ends of the clecos. This is not enough to contaminate the epoxy bond, and it will allow you to pop the cleco out after the epoxy has cured. If you don't like this idea, you might try using plastic food wrap (Saran Wrap) over the end of the cleco.

Note also that the hinge pin may be removed during this bonding operation. The hinge pin is intended to be removable throughout the course of using the cowling. Note on Section G-G how the end of the hinge pin is trapped in a hole in the upper cowling support.

After the hinges are bonded in place, drill the hole in the upper cowling support for the hinge pin.

Next, trim the cowling doors at the forward and aft ends as necessary for a good fit. Trim the cowling doors at the bottom edge to fit within the joggled areas of the lower cowling.

Dzus Fastener Installation

On the Falco cowling we use a type of Dzus fastener not often seen on light aircraft, which normally use the "Standard" line of fasteners. The Standard Dzus fasteners are a pre-WWII design that Dzus wishes people would not use anymore, but they still make them and people buy them.

Dzus fasteners have two unfortunate characteristics. The S-shaped springs used with the Standard Dzus fasteners bend easily, and they do little to hold the fastener from moving sideways. In time, these fasteners become difficult to use, and the hole in the cowling becomes elongated. This problem is solved with the "Supersonic" line of Dzus fasteners that we use. These fasteners are of much higher strength, and the receptacle is of a superior design.

The second problem with Dzus fasteners is that they are primarily designed to be installed on metal parts. The stud is held in place with a copper grommet which is formed tightly against a metal access door. These grommets do not work well with fiberglass, and in time they become loose and start to auger out the hole. We solve this problem by bonding a steel washer on each side of the fiberglass door. This creates a "hard point" which will not be susceptible to the problems inherent with fiberglass. If you wish, you may bond the grommet as well, and we think this is a good idea, but you should be careful not to get the epoxy on the stud so that it will not turn in the grommet. (A light coat of oil on the stud should prevent this, in the event that the epoxy gets squeezed out of the grommet and on to the stud.)

When we shipped the first cowlings for the Falco, some builders objected to the wing fasteners used on the cowling doors. Our experience with aircraft with various types of fasteners convinced us that the wing fasteners are vastly superior. With wing fasteners, you can easily open the cowling doors without any tools. The screwdriver needed for other fasteners ends up scratching the paint. The wings of the fasteners are lined up with the flow of the air so they will have essentially zero effect on the speed of your Falco. Once painted, they are not apparent and do not detract from the appearance of the plane.

With the cowling door held firmly in place, locate the four holes for the Dzus fasteners and drill .375" through the door and lower cowling.

The fasteners provided have a grip length of .251"-.260", measured from under the head of the stud to the face of the receptacle. The doors and lower cowling must be sanded to give the correct grip length. Note that the grommet will add .020", and the washer on the outside of the door will add .032" of additional thickness. For trial fit, use two AN960-616L washers under the head of the stud (to approximate the thickness of the grommet and washer).

Install the receptacle. To assure that the receptacle is centered on the hole, you may try using a short length of 3/8"Ø aluminum tubing, reamed to fit over the stud. There is a slight angular tolerance on the receptacles and studs, so if you wish, you may make up matched sets of studs and receptacles and install the receptacle so that the wing of the stud is correctly aligned. If desired, the receptacles may be installed with MS20426A4 rivets (and with epoxy if you wish).

Bond the washers on the door. Use P/N 840-22 epoxy kit (3M 2216B/A) provided.

When the epoxy is hard (allow 24 hours), insert the grommet and set using Dzus tool #1 and side "A" of block #2. (The Dzus installation tools for the 5/16" "Standard" Dzus fasteners are used for the Dzus "Supersonic" studs.)

If desired, additional epoxy may be used when clinching the grommet. To clinch the grommet, insert the stud and clinch using tool #3 and side "C" of block #1.

Enlarge the .375"Ø hole in the lower cowling to .703"Ø, or at least enough to clear the washer and grommet on the inner face of the cowling door.

The inside of the receptacles and the studs should be lubricated with light oil for smoothest action. A little oil makes a big difference in how well these fasteners work. Also, the oil will keep paint from sticking to the fasteners, which will make them difficult to use.

At this time the cowling may be removed from the airplane.

Exhaust Port Shield and Horn Installation

If available, install the exhaust port shield. See Drawing No. 132, Exhaust System Installation.

If available, install the exhaust port horn. See Drawing No. 132, Exhaust System Installation. The bottom of the exhaust port horn must be trimmed to fit the cowling. Allow about 1/8" clearance between the cowling and the horn, then install the chafe-seal. You may find that the horn must be trimmed a little more than 1/8".

Remove the cowling installation jig, pack it up with all hardware on the shipping ticket and return it to Sequoia Aircraft Corporation for refund of the purchase price.

Landing Light Installation

The landing light installation is shown on Drawing No. 134, Section B-B. Glue on the three spruce blocks to match the locations of the holes in the landing light retaining ring, P/N 840-14, and cover with several layers of fiberglass cloth and epoxy resin.

> *Note*. The landing light installation has required some guesswork. The angle of the light may require some adjustment once you see how it works.

The life of a landing light is substantially shortened by vibration. The rated average *laboratory* life of the landing light bulb is 25 hours. The life of the bulb in a high vibration environment may be shorter. On some aircraft, the bulbs last substantially longer if the filament is vertical, on others the filament should be horizontal. The level of vibration might be reduced by putting a bead of silicone rubber RTV compound on the edge of the fiberglass strip, or using some other rubber strips. Let us know if you find anything that seems to work well.

Install the landing light by pilot drilling the three wood blocks.

The wires for the landing light should be routed along the inside of the lower cowling and covered with a strip of fiberglass cloth and epoxy resin. At the aft end, you should install wrist-lock connectors and cover these with plastic "spaghetti" tubing. These should be staggered so that they will not short out against each other in the event that the plastic tubing is dislodged. Locate the connectors where they are easily accessible. The wiring should be routed so that it is away from the exhaust pipes.

If the exhaust system is installed, install a piece of stainless steel sheet at any area where the exhaust pipe is closer than one inch from the lower cowling. The cowling is made of fire-retardant polyester resin, but the fiberglass will char slightly at any close points.

Once the landing light is installed, it may be removed until final installation.

Landing Light Lens Installation

The landing light lens should be installed using P/N 840-22 epoxy kit (3M 2216B/A). Where it will be bonded to the fiberglass, the lens should be scuff-sanded with 60 or 80 grit sandpaper.

The depth of the joggle for the landing light will vary slightly, accordingly, you should exercise great care in installing the lens so that it is flush with the outer surface of the cowling.

Baffling Installation

See Drawing No. 133 Engine Baffling Installation. The baffles must be fitted to the engine. The Lycoming engines vary in the shape of the casting used for the crankcase. The baffling drawings were done by exactly matching the shape of the crankcase of one engine. In the lucky event that you have an identical engine, you should be able to install the baffling in a few minutes!

The baffling uses a rubber chafe-seal between the baffling and the crankcase. You should trim the baffling so that it is 1/8" from the crankcase, and then make any final adjustments once the chafe-seal is trial-fitted. The chafe-seal keeps the baffling from wearing on the crankcase and seals against air leaks.

The right aft baffle must be modified, per Detail F, to match the engine that you have.

At the sides the front and aft baffles are joined with a MS9551-010 strap. The holes in the straps are larger than the screws used. This is provided to allow the cylinders to move about (as they actually do) without the baffling resisting this motion. Accordingly, the screws should be tightened only enough to bring all of the parts together. Do not over tighten. Notice the overlap of the metal baffles and rubber baffle seals. The front baffle or seal in installed so that it is on the inside of the aft equivalent so that the rush of the air will not tend to open things up.

You will need to drill 1/16"Ø holes in the intercylinder baffles (supplied with the engine) for the springs which hold the cylinder and cylinder head baffles in place.

The right front baffle assembly is the most difficult to install. The oil galley tube which supplies pressurized oil to the propeller must be removed and passed through the baffle. The hole in the baffle is large enough for the nut on the tube fitting, but the line must be disconnected from the engine at both ends to be able to get it through the baffling. The baffling is designed to work with an alternator with no idler pulley. Some Lycoming engines are supplied with a separate idler pulley. This will cause a huge interference problem with the baffling.

Final Adjustment and Fine Tuning

After the cowling and baffling are installed, there is still much that can be done to increase the efficiency of the cooling system.

Before the nose gear door is installed, you can expect that the engine will run cooler than is optimum, since the nose gear fairing acts as an extractor. We suggest that you do not attempt to fine tune the system until the nose gear door is installed. In the meantime, you can consider doing the following:

There will be a number of little holes in the baffling. These can be sealed with silicone rubber RTV compound.

The cowling hinge is something of a sieve. Take a look through the cooling intake of the cowling at the amount of daylight that shines through. To seal this, you can use two pieces of plastic tape, one narrow and one wide. The narrow tape should be about the same width of the area you wish to seal. Tape this to the sticky side of the wide tape, thus preventing the wide tape from being sticky over its entire width. This can then be taped to the hinge on the cowling side or to the cowling support angle. This plastic tape will form a flap which covers the hinge at the bottom. The air pressure will push it tightly shut.

Adjust the intercylinder baffles so that each cylinder has the same opening at the bottom. The key to even cooling is to have each cylinder "seeing" the same amount of air.

There is much that can be done on the upper cowling. As it is supplied, the inside edges of the intakes are of a smooth airfoil shape. This shape joins the upper inside surface of the upper cowling at the forward edge of the door. At the inboard side of the inlet, the inlet fairing stops.

The object is to admit air into the engine with the least possible resistance. Remember that the air is quickly slowing down, so smooth surfaces mean more at the immediate area of the inlet. The shaping of the upper inside of the inlet is very similar to what is done on the Mooney 201.

If you wish, you may take this concept a little further. The fairings on the inside may be extended down the the baffling. We considered doing this on the kits, but this would have been prohibitively expensive. The extensions would have quickly broken off in shipping. In addition, you would like to be able to preflight the alternator belt. By having an open area you can easily do this. If you seal things right down the the baffling, this will no longer be possible, and such a preflight maneuver will have to be accomplished by reaching under the front cylinder from the right access door.

Remember that the engine moves around quite a bit. We have provided room for about 1/2" between the baffling and the cowling. This extension of the upper cowling inlet fairing should also have rubber seals at the bottom.

If you wish, you may continue the inlet fairing back a couple of feet so that it forms a complete streamlined shape with the spinner. This "reverse spinner" within the cowling would be fitted to the shape of the engine. A nice touch, but lots of trouble. We don't know if this is worth the trouble, but surely someone will try it.

If you are going to go for the ultimate, we suggest you consider sealing against spillage of upper deck air by the starter ring. Particularly with the nose gear fairing open (therefore acting as an extractor) the "delta P", or pressure difference between the upper and lower deck is very great. This causes air in the upper deck to seek any possible route to the lower deck. One such area—and it is surprisingly large—is around the starter ring. If you remove the upper cowling, you can see this problem. Air will travel forward at the center if the airplane and pass down around the starter ring. Worse yet, it will tend to filter out behind the spinner, spill out of the opening between the spinner and then come back into the engine! Obviously, this is not the model of efficiency.

The best way to seal this is to install a seal on the upper cowling. To to this, we suggest that you glue a piece of foam (say 1/2" thick) so that it is in line with the aft ends of the inside inlet fairings, and goes straight across the engine (at right angles to the crankshaft). This foam piece is then fitted to the engine so that it clears by 1/2". Then cover the foam with fiberglass and epoxy or polyester resin. Install a rubber seal on the aft edge so that it seals against the engine crankcase. This may seem like a lot of foolishness, but we would not be surprised if this one change produced a speed increase of 3 to 4 mph.

If you wish, you may want to seal between the cowling and the spinner. The space provided is large by some "designers" standards, but you should remember that the Falco is an acrobatic airplane. During acrobatics, the engine will move around a surprising amount. Early Pitts aircraft, which had the cowling installed close to the spinner, had problems with the spinner contacting the cowling. For this reason, we provided enough room for clearance during acrobatics.

At the other end of the spectrum, the GP-4 aircraft of George Pereira has an opening of only about .030" between the spinner and the cowling. This is wonderful for speed, but could lead to an unsafe condition if something went wrong.

Some of the people doing speed mods on production aircraft have installed brush-seals. These are brushes installed in an aluminum extrusion. They have to be specially formed to the round shape of the spinner. The brush-seal is installed on the cowling with the bristles contacting the spinner. The spinner quickly wears the nylon bristles to that they clear. We don't know how much speed can be had from this sort of thing. Most honest speed mod merchants will admit that they cannot measure the incremental benefit of such a small thing, but that a lot of such things are installed on their fast aircraft.

At the inlets, there is a little drag which can be eliminated by installing fairings on the baffles. The inlets are rounded, while the baffling are squared off at the front. If you wish, you can glue some foam on the baffles and sand so that it continues the shape of the cowling inlet. This is easy to do on the right front. On the left front, this sort of fairing will cover up the screws for the oil cooler support. Fanatics might provide a small hole and cover with tape. It is also possible to remove the oil cooler with the forward oil cooler support in place, so fanatics might want to try that.

When the nose gear door is installed, final adjustments to the cooling should be done by restricting the size of the exits. The control of the cooling should be by reducing the extraction, not by reducing the side of the inlets.

The Nose Gear Door

The nose gear door (the "cowling door") and the nose gear bay doors (the clamshell doors between Sta. 1 and 3) are now shown on two preliminary drawings.

The nose gear door installation drawing is self-explanatory. This door is only for the engines with the injector on the aft end of the engine. This door is something that we may make later as a separate part. For now, you may cut the door out of the cowling. All builders to date have done this. You do want to make sure that the door has some overlap with the cowling, as is shown in the drawing. Note that the rocker arm must be modified to clear this door.

The Nose Gear Bay Doors

The nose gear bay is an aerodynamically dirty opening of nearly one square foot. Installing the doors will give you about 10 knots at top speed and 7 knots at cruise.

Somewhere in the process, the nose gear grew in length, with the result that it was 18mm longer than the nose gear on the production Falcos. To remedy this, a new P/N 660A guide and stop was made and shipped. The drawing for the nose gear bay doors shows the nose gear in the new, shorter length.

The torque links will stick out more. Ideally, they should be 96mm long and are shown at that length on the nose gear bay door drawing. It appears that the best solution is to re-drill one of the torque links to bring them to the approximate position shown.

The design of the nose gear bay doors and the closing mechanism is adapted from Luciano Nustrini's Falco. A nylon tube is used to keep the spring from damaging the chrome plating on the nose gear. The spring holds the doors open, and the gear hits the spring and pulls the doors shut when the gear is retracted.

To keep the doors from opening too far, a phenolic wedge is used to contact the spring. One Falco builder has installed this system without any "open stops" and hasn't had any difficulties—the doors will rack left and right slightly, but it doesn't seem to make any difference.

For the "close stop" Nustrini's airplane has an aluminum bracket which hits the sides of the nose gear bay and keeps the doors from closing too far. The doors on Nustrini's Falco are made of .040" aluminum. Since our doors are made of fiberglass, we suggest that the stops be made of spruce. Since these blocks hit the walls of the nose gear bay, it would be a good idea to put a brace of spruce on the other side of the plywood. For aircraft already finished, an extra piece of plywood could be put on the inboard side of the wall.

Although these "close stops" seem essential, no homebuilt Falcos have used this type of stop. The reason is that the doors already have a couple of built-in stops. The two doors hit at the blister for the tire, and this keeps the doors from closing too far. At the aft end, it is a good idea to have the doors overlap the fuselage skin, and this creates another stop.

The spring on Nustrini's Falco is made of .135"Ø music wire, but we have found that springs made of 1/8"Ø music wire have proved to be sufficiently strong, and that wire is much easier to work with than 5/32". Nustrini's spring is 175mm wide in the relaxed, open condition. When the doors are open, the springs exert almost no force to keep the doors open. This seems surprising until you try to close the spring. The spring force builds up rapidly. By compressing the spring 1", the spring force is 3 pounds. When the doors are fully closed, the spring exerts an opening force of about 10 pounds.

To make a bending jig, use a thick board and drill the holes shown in Figure 1. The smaller hole may be for a 1/4" bolt, or anything else that is handy. Intall 5/8"Ø dowels in the larger holes and epoxy in place (the inside diameter of the coils ends up about .100" larger than the dowels). The 5/8" dowels should stick up by about 3/4".

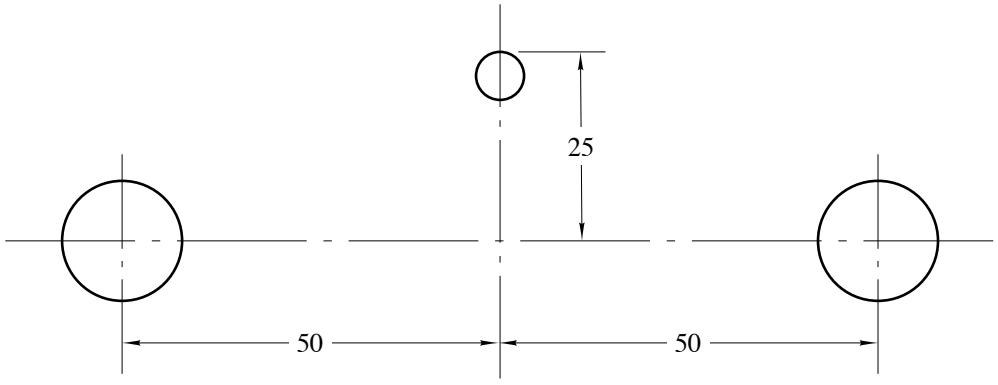

Figure 2

Music wire is available a hobby shops in 36" lengths. Prebend the wire to an approximate 20mm radius so it will fit across the three pins as shown in Figure 3. The spring will require about 30" of wire, so bend the piece in the middle. Mark the location for the two additional 1/4" bolts shown in Figure 3 and drill. These bolts will have to be removable so that you can get the spring off the bending jig when you are finished.

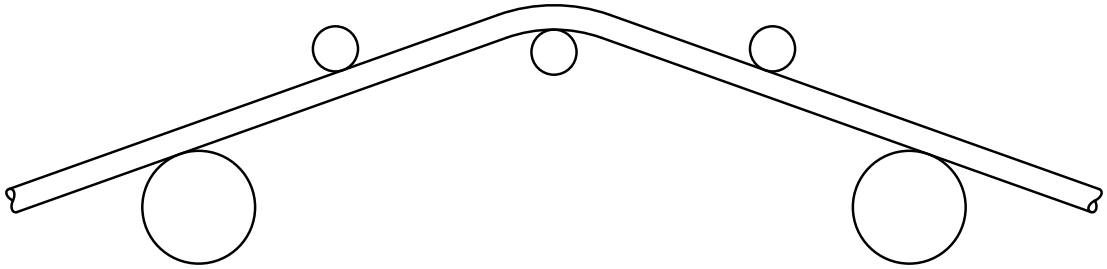

Figure 3

You are now ready to bend the spring. Try to keep the wire as flat as possible with the top of the bending jig, or the wire will "climb" the 5/8"Ø dowels too quickly. Bend the wire around the 5/8" dowels twice and then bend the ends for the desired width. Since you will probably have to make several springs, draw the angle of the open spring on the jig for future reference.

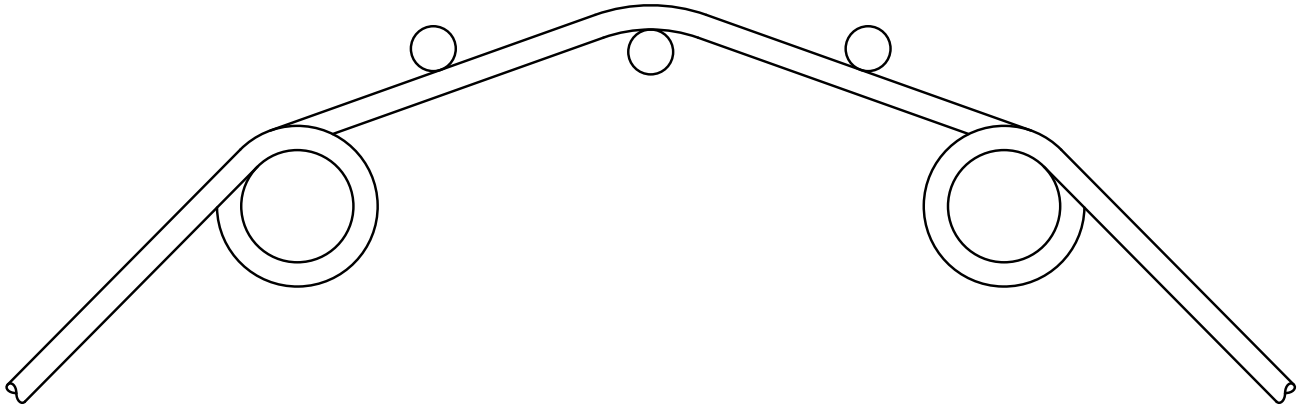

Figure 4

It does not matter if the coils are exactly round. Chances are that yours will be more of a slightly loose spiral than the tight coil shown. All of the springs we have seen were like that. These things do not matter—you might lose a few points in show-plane judging, but it will have no effect on the action of the gear doors.

Finally, bend the ends of the springs to the required length for your installation. Put the wire in the vise, pull it over and tap it with a soft hammer. This is the tricky part—there is very little adjustment that can be made to the spring once it is bent. If the spring is too short, you can try bending it a little more in the middle. If the spring is too long, so the doors do not close completely, you can replace the nylon tubing with two blocks of wood—sandwiched over the spring and held in place with two screws. Sand the blocks to the exact size needed to bring the doors to the closed position.

Nustrini's spring is drilled with 1/16"Ø holes at each end and cotter pins are used to secure the spring. Since music wire is relatively hard, it is difficult to drill such a hole. Start by making a drill jig: a block of steel or aluminum drilled one way with a 1/8"Ø hole and the other way with a 1/16"Ø hole. The spring is inserted into the 1/8" hole, and you drill the wire. This will position the hole in the spring.

If you are unable to drill the spring, you can use a screw collar (or "set collar"). These are sold by hobby shops for model airplane axles. Grind a little flat place on the spring for the set screw to seat.

The two clips to secure the spring to the doors may be made of aluminum or steel. On Nustrini's doors, the clips are made of steel.

To flight test the door installation, take off and leave the landing gear down. Fly in formation with another aircraft. Fly the Falco at maximum landing gear extension speed and apply full left and right rudder. If the doors stay open through all of this, then the installation is fine. If the doors close and remain closed, you will need to change the spring so that it exerts a stronger force to keep the doors open. The only risk that we see is that one or both doors would close while the gear is down, thus interfering with landing gear retraction. Because of the geometry of the spring, it seems unlikely that both doors would remain closed, but one door could close and be held closed while the other remains open.

When you first make the spring, you will probably be wary of the light forces needed to start the doors closed, but you will notice that the spring forces build up very rapidly so that to close the doors, a considerable force is required. Because these doors are aft of the nose gear door (mounted on the trunnion) the aerodynamic forces on these doors will be relatively light.