F.8L Falco Flight Test Guide

Chapter 1
Final Inspection

Introduction

The purpose of this guide is to offer advice and guidance for the final inspection of the aircraft and to assist in the planning, preparation and actual flight testing of the Falco. Many long and expensive hours have gone into any homebuilt construction which can be lost or destroyed in a matter of seconds without prior preparation or knowledge for the first flight. The more experience, knowledge of its systems, expectations with fewer surprises, the safer and more rewarding the first flight will be.

Many requirements must be met prior to the first flight. All FAA inspections, airworthiness, registration, weight and balance, licenses, pilot qualifications, placards, restriction, logs, etc. should be completed prior to any testing. It's too easy to become airborne on taxi testing so do all the paperwork first. The EAA has many publications to assist in this preparation, and these are highly recommended.

Final Inspection

The purpose of this list is to compile the most exhaustive check list possible for the aircraft and to provide a system for checking all nuts, bolts, fittings, safety wire, and security. Unlike a normal pre-flight inspection, this check list follows a systems approach. The intent is to make you think about the system that you are checking, without regard to the number of times you will have to climb into the cockpit.

Whatever you do, don't forget to *think*. While you are checking a system—the elevator controls, for example—think about what the system is supposed to do. Try to find anything that will prevent the system from working as intended.

No check list can assure that you built the aircraft correctly, but there are certain things which should be paramount in your mind. Cotter pins and safety wire are incredibly important. They are tiny things and always a pain-in-the-neck to install, so it's possible you did not install all of them. A missing cotter pin is a fatal accident waiting to happen. For each and every cotter pin in your airplane, over the history of aviation there have probably been at least ten pilots killed because that specific cotter pin—say the cotter pin at the aft end of the elevator pushrod—was forgotten. We are talking about dead people here: funerals, widows, and children raised without a parent around. Cotter pins and safety wires are important to your safety—do they now have your full attention?

Every year pilots are killed because of the most improbable mistakes. Occasionally, the controls are hooked up wrong so that "stick left" actually rolls the airplane the opposite direction. Of the first three homebuilt Falcos to fly, two had the governor controls hooked up backwards, and one had the elevator trim controls reversed. We've had one fuel tank partially collapsed because the tank vent was plugged. There have been loose fittings in the fuel system and in the oil line for the engine. We've had a nose gear axle nut depart the airplane because the safety screws were not installed. We've had a main gear collapse because the builder had not checked to see if the side load strut was actually over-center. While none of these incidents with homebuilt Falcos resulted in any injuries, they were all avoidable.

Reviewing the statistics of accidents involving homebuilt aircraft shows that engine failures play a role in one of every three accidents (compared to one in every four accidents involving production aircraft) and fuel-system problems were most often cited as the reason. These include fuel contamination (water, debris, clogging by flakes of fiberglass dislodged from the fuel tank), obstructed fuel vents, incorrectly assembled or adjusted carburetors/injectors, carburetor icing, fuel-system leaks and fuel-system mismanagement. Most accidents and problems on first flights of homebuilt aircraft are the result of fuel system problems. Thus, you should exercise extreme care to assure the proper operation of the fuel system before any flight is attempted. Even after the aircraft is in the air, you should stay within gliding distance of the airport until you have confidence that the fuel system is working properly.

We all have the tendency to view the mistakes of others as something that we would not do. Make a bad mistake in flying, and you can end up as a smoking hole in the ground surrounded by experts saying "Why in the hell did he do *that*?" "That would never happen to me" is a poor way to avoid mistakes—better to assume that it could happen to you, and then think about what you can do to prevent that from happening. It's best to develop a full card-carrying paranoia about things-that-could-go-wrong during the final inspection.

Major aircraft manufacturers have long ago discovered the value of having a fresh pair of eyes inspecting an aircraft before its first flight. The mechanics who have built the aircraft have usually worked on the aircraft night and day, and they are too familiar with it to give it an objective inspection. A "fresh pair of eyes" is a revered institution at test facilities. At Sikorsky, for example, a team of mechanics are brought in for the final inspection. These same mechanics are intentionally kept away from the aircraft during its construction.

The "fresh pair of eyes" inspection system works! As any writer can tell you, your own writing is the most difficult to proof—you "read" the words you intended to write but never put on paper. It is the same with building an aircraft. Unless you are a fool hell-bent on entering the hereafter, get all the help you can on the final inspection. Make copies of this check list and hand them out to your inspectors.

Our strong recommendation is that you *hire* an A&P mechanic to inspect your airplane. Get a mechanic who works on aircraft every day. Pay him his normal shop rate. With all the time and money you have in your airplane, it only makes sense, but when you consider the possible risk to your life (or that of your test pilot) it seems to us to be the only sensible course of action. Your FAA inspector can be an invaluable help, and you should provide him with a copy of this check list. Go over the aircraft with a fine tooth comb. Thoroughly check *every* component and system in the aircraft.

We may have omitted something, but here goes:

Remove for inspection:

Aileron bellcrank access panel, left wing.
Landing gear nut access panel, left wing.
Landing gear and flap torque tube access panel, left wing.
Main landing gear wheel cover (hubcap), left wing.
Aileron bellcrank access panel, right wing.
Landing gear nut access panel, right wing.
Landing gear and flap torque tube access panel, right wing.
Main landing gear wheel cover (hubcap), right wing.
Autopilot servo access panel, right wing.
Left Seat
Right Seat
Cockpit floor board, left side at control stick.
Cockpit floor board, right side at control stick.
Center console covers from instrument pedestal to luggage compartment.
Rear bulkhead of luggage compartment.
Luggage compartment floor.
Rudder pulley access panel at front fin spar.

Control System:

At left wing:

Outboard aileron hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Outboard aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Outboard aileron hinge to aileron spar	Installed with two bolts. Nuts tight.
Center aileron hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Aileron hinge and control arm to aileron spar	Installed with four bolts. Nuts tight. Grease or Tri-Flow oil on spherical bearing.
Outboard center aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Inboard center aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Aileron stop	Installed with bolt. Nut tight.
Aileron/flap hinge	Hinge bolt, washers (2), nut and cotter pin.

	Tri-Flow oil.
Aileron/flap hinge to aft wing spar	Installed with four bolts. Nuts tight.
Inboard aileron hinge to aileron spar	Installed with two bolts. Nuts tight.
Outboard flap hinge to flap spar	Installed with two bolts. Nuts tight.
Inboard flap hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Inboard flap hinges (2) to aft wing spar	Installed with two bolts per hinge. Nuts tight.
Inboard flap hinge and control arm to flap spar	Installed with four bolts. Nuts tight. Grease or Tri-Flow oil on spherical bearing.
Upper aileron bellcrank support to main wing spar	Installed with two bolts. Nuts tight.
Lower aileron bellcrank support to main wing spar	Installed with two bolts. Nuts tight.
Aileron bellcrank	Pivot bolt, washer, nut and cotter pin. Grease or Tri-Flow oil on spherical bearing.
Forward aileron cable to aileron bellcrank	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Forward aileron cable	Tension 45 lbs ± 2 lbs.
Aft aileron cable to aileron bellcrank	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Aft aileron cable	Tension 45 lbs ± 2 lbs.
Aileron bellcrank to aileron pushrod	Bolt, washer, nut and cotter pin.
Aileron pushrod to control arm & hinge	Bolt, washer, nut and cotter pin.
Aileron	Control movement 24° up, 16° down. Balanced: 18.5±2.5oz download at T.E. midspan. Smooth operation. Interference? Friction?
Aileron bellcrank	Smooth operation. Interference? Friction?

At right wing:

Outboard aileron hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Outboard aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Outboard aileron hinge to aileron spar	Installed with two bolts. Nuts tight.
Center aileron hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Aileron hinge and control arm to aileron spar	Installed with four bolts. Nuts tight. Grease or Tri-Flow oil on spherical bearing.
Outboard center aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Inboard center aileron hinge to aft wing spar	Installed with two bolts. Nuts tight.
Aileron stop	Installed with bolt. Nut tight.
Aileron/flap hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Aileron/flap hinge to aft wing spar	Installed with four bolts. Nuts tight.
Inboard aileron hinge to aileron spar	Installed with two bolts. Nuts tight.
Outboard flap hinge to flap spar	Installed with two bolts. Nuts tight.
Inboard flap hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Inboard flap hinges (2) to aft wing spar	Installed with two bolts per hinge. Nuts tight.
Inboard flap hing and control arm to flap spar	Installed with four bolts. Nuts tight. Grease or Tri-Flow oil on spherical bearing.
Upper aileron bellcrank support to main wing spar	Installed with two bolts. Nuts tight.
Lower aileron bellcrank support to main wing spar	Installed with two bolts. Nuts tight.
Aileron bellcrank	Pivot bolt, washer, nut and cotter pin. Grease or Tri-Flow oil on spherical bearing.
Forward aileron cable to aileron bellcrank	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Forward aileron cable	Tension 45 lbs ± 2 lbs.
Aft aileron cable to aileron bellcrank	Bolt, washer, nut and cotter pin. Tri-Flow oil.

Aft aileron cable	Tension 45 lbs ± 2 lbs.
Aileron bellcrank to aileron pushrod	Bolt, washer, nut and cotter pin.
Aileron pushrod to control arm & hinge	Bolt, washer, nut and cotter pin.
Aileron	Control movement 24° up, 16° down. Balanced: 18.5±2.5oz download at T.E. midspan. Smooth operation. Interference? Friction?
Aileron bellcrank	Smooth operation. Interference? Friction?

In cockpit:

Control stick, L.H.	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick, L.H. to control stick connecting rod	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick, L.H. to forward aileron cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Forward aileron cable, L.H.	Turnbuckle safetied.
Aft aileron cable	Turnbuckle safetied.
Control stick torsion tube pivot point, L.H.	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick supports, L.H. (2)	Installed with two bolts per support. Nuts tight.
Control stick, R.H.	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick, R.H. to control stick connecting rod	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick, R.H. to forward aileron cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Forward aileron cable, R.H.	Turnbuckle safetied.
Control stick torsion tube pivot point, R.H.	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Control stick supports, R.H. (2)	Installed with two bolts per support. Nuts tight.
Control stick torsion tube to elevator pushrod	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Control sticks	Smooth operation. Interference? Friction?

In aft cockpit:

Elevator pushrod to elevator bellcrank	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Elevator bellcrank	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Elevator bellcrank supports (2)	Installed with six bolts. Nuts tight.
Elevator bellcrank to upper elevator cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Elevator bellcrank to lower elevator cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Upper elevator cable	Tension: 45 lb ± 2 lb.
Lower elevator cable	Tension: 45 lb ± 2 lb.
Upper elevator cable	Turnbuckle safetied.
Lower elevator cable	Turnbuckle safetied.
Elevator bellcrank, pushrod and cables	Smooth operation. Interference? Friction?

At elevator:

Elevator hinge, L.H. .... Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Elevator hinges, L.H. (2) to main stabilizer spar .... Installed with 2 bolts per hinge. Nuts tight.
Elevator hinge, L.H. to elevator spar .... Installed with 4 bolts. Nuts tight.
Elevator hinge, center .... Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Elevator hinges, center (2) to main fin & stab. spars .... Installed with 2 bolts per hinge. Nuts tight.
Elevator hinge, center to elevator spar .... Installed with 4 bolts. Nuts tight.
Elevator hinge, R.H. .... Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Elevator hinges, R.H. (2) to main stabilizer spar .... Installed with 2 bolts per hinge. Nuts tight.
Elevator hinge, R.H. to elevator spar .... Installed with 4 bolts. Nuts tight.
Elevator control arm to upper elevator cable .... Bolt, washer, nut and cotter pin. Tri-Flow oil.
Elevator control arm to lower elevator cable .... Bolt, washer, nut and cotter pin. Tri-Flow oil.
Elevator balance weight and arm .... Installed.
Elevator stops .... Installed.
Elevator .... Control movement 22° up, 16° down. Balanced: 39±6oz download at T.E. midspan. Smooth operation. Interference? Friction?

At elevator trim tab:

Control cable .... Installed in elevator with 2 bolts. Nuts tight.
Control cable to trim tab control arm .... Bolt, washer, nut and cotter pin. Tri-Flow oil.
Trim tab control arm .... Installed with 3 screws.
Elevator trim tab hinges (2) .... Installed with 6 screws per hinge. Tri-Flow oil.
Elevator tab .... Smooth operation. Interference? Friction?

At elevator trim tab controls:

Control cable to screwjack .... Bolt, washer, nut and cotter pin. Tri-Flow oil.
Screwjack to angle drive .... Installed with roll pin.
Screwjack threads .... Tri-Flow oil.
Angle drive mounting bracket to cockpit floor .... Installed with 4 screws.
Angle drive to mounting bracket .... Installed with 4 screws. Nuts tight.
Screwjack guide bracket to fuselage frame .... Installed with 2 screws.
Control cable to landing gear gearbox .... Installed with two bolts. Nuts tight.
Trim tab controls .... Check installation. Smooth operation? Interference?

At forward cockpit:

Left rudder pedal torque tube .... L.H. pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder pedal torque tube support, left outboard .... Installed with 2 bolts. Nuts tight.
Right rudder pedal torque tube .... L.H. pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder pedal torque tube support, left inboard .... Installed with 2 bolts. Nuts tight.
Brake pedal, L.H. .... Washer, and cotter pin installed. Tri-Flow oil.
Brake pedal, R.H. .... Washer, and cotter pin installed. Tri-Flow oil.
Master cylinder, L.H. .... Upper bolt, washer, nut and cotter pin.

	Tri-Flow oil.
Master cylinder, L.H.	Lower bolt, washer, nut and cotter pin. (?) Tri-Flow oil.
Master cylinder, R.H.	Upper bolt, washer, nut and cotter pin. Tri-Flow oil.
Master cylinder, R.H.	Lower bolt, washer, nut and cotter pin. (?) Tri-Flow oil.
R.H. rudder pedal torque tube to rudder cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
R.H. rudder pedal torque tube to nose gear steering cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Brake pedals	Smooth operation. Interference? Friction?
Left rudder pedal torque tube	R.H. pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder pedal torque tube support, right inboard	Installed with 2 bolts. Nuts tight.
Right rudder pedal torque tube	R.H. pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder pedal torque tube support, right outboard	Installed with 2 bolts. Nuts tight.
L.H. rudder pedal torque tube to rudder cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
L.H. rudder pedal torque tube to nose gear steering cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder pedals	Smooth operation. Interference? Friction?

At frame No. 3:

Rudder cable pulley, L.H.	Check installation and guard installed. Smooth operation.
Rudder cable pulley bracket, L.H. to front wing spar	Installed with two bolts. Nuts tight.
Rudder cable pulley, R.H.	Check installation and guard installed. Smooth operation.
Rudder cable pulley bracket, R.H. to front wing spar	Installed with two bolts. Nuts tight.

At frame No. 5:

Rudder cable pulley, L.H.	Check installation and guard installed. Smooth operation.
Rudder cable pulley bracket, L.H. to fuselage frame	Installed with two bolts. Nuts tight.
Rudder cable pulley, R.H.	Check installation and guard installed. Smooth operation.
Rudder cable pulley bracket, R.H. to fuselage frame	Installed with two bolts. Nuts tight.

At frame No. 6:

Rudder cable, L.H.	Turnbuckle safetied.
Rudder cable, L.H.	Tension: 38 lb. ± 2 lb.
Rudder cable, R.H.	Turnbuckle safetied.
Rudder cable, R.H.	Tension: 38 lb. ± 2 lb.

At front fin spar:

Rudder cable pulley	Check installation and guard installed. Smooth operation.
Rudder cable pulley bracket to front fin spar	Installed with two bolts. Nuts tight.

At rudder:

Upper rudder hinge	Hinge bolt, washers (2), nut and cotter pin. Tri-Flow oil.
Upper rudder hinge to main fin spar	Installed with 2 bolts. Nuts tight.
Upper rudder hinges (2) to rudder spar	Installed with 2 bolts per hinge. Nuts tight.
Lower rudder hinge	Hinge bolt, washers (2), nut and cotter pin.

	Tri-Flow oil.
Lower rudder hinges (2) to main fin spar	Installed with 2 bolts per hinge. Nuts tight.
Rudder control arm to rudder spar	Installed with 4 bolts. Nuts tight.
Rudder control arm to R.H. rudder cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder control arm to L.H. rudder cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Rudder stops	Installed.
Rudder	Control movement 20° right, 20° left. Balanced: 24±3oz download at T.E. midspan. Smooth operation. Interference? Friction?

Engine compartment:

Nose gear steering arm to engine mount	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Nose gear steering arm to L.H. eyebolt	Nut, washer and cotter pin. Tri-Flow oil.
L.H. eyebolt to L.H. nose gear steering cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
L.H. nose gear steering cable	Turnbuckle safetied.
Nose gear steering arm to R.H. eyebolt	Nut, washer and cotter pin. Tri-Flow oil.
R.H. eyebolt to R.H. nose gear steering cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
R.H. nose gear steering cable	Turnbuckle safetied.
L.H. roller in nose gear steering arm	Clevis pin and cotter pin. Tri-Flow oil.
R.H. roller in nose gear steering arm	Clevis pin and cotter pin. Tri-Flow oil.

Controls conformity check:

Control stick back	Elevator up.
Control stick forward	Elevator down.
Control stick right	Left aileron down, right aileron up.
Control stick left	Left aileron up, right aileron down.
Push right rudder pedal	Front of nose gear tire to right and trailing edge of rudder to right
Push left rudder pedal	Front of nose gear tire to left and trailing edge of rudder to left
Roll top of elevator trim wheel forward	Trailing edge of trip tab up and indicator to "nose down"
Roll top of elevator trim wheel aft	Trailing edge of trip tab down and indicator to "nose up"

Flap Control System:

At flap motor:

Flap torque tube to flap torque tube support	Pivot bolt, washer, nut and cotter pin. Tri-Flow oil.
Flap torque tube support to fuselage bottom	Installed with two screws. Nuts tight.
Flap torque tube to flap actuator	Washers (2), nuts (2) and cotter pins (2). Tri-Flow oil.
Flap actuator to flap actuator supports	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Flap actuator supports (2) to fuselage bottom	Installed with 2 screws per support. Nuts tight.

In left wing:

Flap torque tube at pivot in wing	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Flap torque tube support to wing rib	Installed with 4 bolts. Nuts tight.
Flap torque tube to flap pushrod	Bolt, washer, nut and cotter pin.
Flap pushrod rod end bearing	Installed with check nut. Grease or Tri-Flow oil on spherical bearing.
Flap pushrod to control arm and hinge	Bolt, washer, nut and cotter pin.
Flap	Smooth operation. Interference? Friction?

In right wing:

Flap torque tube at pivot in wing	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Flap torque tube support to wing rib	Installed with 4 bolts. Nuts tight.
Flap torque tube to flap pushrod	Bolt, washer, nut and cotter pin.
Flap pushrod rod end bearing	Installed with check nut. Grease or Tri-Flow oil on spherical bearing.
Flap pushrod to control arm and hinge	Bolt, washer, nut and cotter pin.
Flap	Smooth operation. Interference? Friction?

Engine Controls System:

Throttle quadrant:

Throttle control arm to throttle control cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Throttle ctl cable to bracket on nose wheel bay cover	Nuts tight.
Propeller control arm to propeller control cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Prop ctl cable to bracket on nose wheel bay cover	Nuts tight.
Mixture control arm to mixture control cable	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Mixture ctl cable to bracket on nose wheel bay cover	Nuts tight.
Cabin heat control cable to center pedestal panel	Installed with nut tight.
L.H. throttle arm to pushrod	Bolt, washer, nut and cotter pin.
L.H. throttle pushrod to torque tube	Clevis pin and cotter pin. Tri-Flow oil.
L.H. throttle torque tube at left end	Washer and cotter pin. Tri-Flow oil.
L.H. throttle torque tube at right end	Washer and cotter pin. Tri-Flow oil.
L.H. throttle torque tube to center pushrod	Clevis pin and cotter pin. Tri-Flow oil.
Center pushrod to throttle control arm	Nut, washer and cotter pin. Tri-Flow oil.
Throttle control arm	Smooth operation. Interference?
Propeller control arm	Smooth operation. Interference?
Mixture control arm	Smooth operation. Interference?
Cabin heat control knob	Smooth operation.

Engine compartment:

Cabin heat valve assembly on firewall frame	Installed with 6 screws.
Throttle control cable through cabin heat valve assy	Grommet installed.
Propeller control cable through cabin heat valve assy	Grommet installed.
Mixture control cable through cabin heat valve assy	Grommet installed.
Cabin heat cable through cabin heat valve assembly	Grommet installed.
Cabin heat cable bracket on firewall frame	Bolts (2), washers (2) and nuts (2). Nuts tight.
Cabin heat cable to cabin heat bracket	Clamp, bolt, washer and nut. Nut tight.
Cabin heat cable end to cabin heat valve control arm	Cable end fitting, washer, nut and cotter pin.
Throttle control cable to injector controls fitting arm	Installed with nuts tight.
Injector controls fitting to injector body	Lock washers (4) and nuts (4). Nuts tight.
Throttle control cable to injector	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Propeller control cable to governor control bracket	Installed with nuts tight.
Governor control bracket to governor	Installed with 3 screws and safety wired.
Propeller control cable to propeller governor	Bolt, washer, nut and cotter pin. Tri-Flow oil.
Propeller governor control bracket	Screws safety-wired.
Mixture control cable to injector controls fitting arm	Installed with nuts tight.
Mixture control cable to injector	Bolt, washer, nut and cotter pin. Tri-Flow oil.

Engine controls conformity check:

Throttle	Check.
Propeller control. Push forward to high rpm	Governor lever against adjustment screw.
Mixture control	Check.
Cabin heat control	Valve open straight through when knob pulled.

Landing Gear:

Nose gear:

Axle	Safety screw installed in axle flange.
Axle nut	Safety screw installed.
Wheel bearings	Mobil 28 grease (red).
Lower torque link to eyebolts on nose gear fork	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Lower torque link to upper torque link	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Upper torque link to nose gear upper cylinder	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Nose gear upper ring nut	Safety screw installed.
Nose gear trunnion (left side) to engine mount	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Nose gear trunnion (right side) to engine mount	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Nose gear trunnion to lower drag strut	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Lower drag strut to upper drag strut	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Upper drag strut to drag strut support on left side	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Upper drag strut to drag strut support on right side	Bolt, washer, nut and cotter pin. Mobil 28 grease (red).
Nose gear screwjack to upper drag strut	Bolt, washer, nut and cotter pin.
Nose gear screwjack end fitting to screwjack sleeve	Bolt, washer, nut and cotter pin. Nut backed off half turn from finger tight. Mobil 28 grease (red).
Nose gear screwjack (male threads	Light coat of Aeroshell 17 grease (black)
Nose gear screwjack to universal joint	Taper pin, washer, nut and cotter pin.
Universal joint to nose gear control rod	Taper pin, washer and nut.

In cockpit:

Nose gear control rod to universal joint....Taper pin, washer and nut.
Universal joint to retraction gearbox shaft....Taper pin, washer, nut and cotter pin.
L.H. main gear screwjack to universal joint....Taper pin, washer, nut and cotter pin.
L.H. universal joint to retraction gearbox shaft....Taper pin, washer, nut and cotter pin.
R.H. main gear screwjack to universal joint....Taper pin, washer, nut and cotter pin.
R.H. universal joint to retraction gearbox shaft....Taper pin, washer, nut and cotter pin.
Retraction gearbox gears....Aeroshell 17 grease (black).

At main landing gear nut access panel, left wing:

Forward mount fitting....Installed with four bolts, nuts tight.
Main landing gear at forward mount fitting....Washer, nut and cotter pin.
Mobil 28 grease (red).

At main landing gear, left wing:

Aft main landing gear fitting....Installed with five bolts, nuts tight.
Mobil 28 grease (red).
Main landing gear leg to landing gear arm....Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to upper end of oleo shock absorber Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to lower end of oleo shock absorber Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to side load strut pin....Washer and nut.
Main landing gear leg to lower side load strut....Washer, nut and cotter pin.
Mobil 28 grease (red).
Lower side load strut to upper side load strut....Bolt, washer, nut and cotter pin.
Mobil 28 grease (red).
Upper side load strut to side load fitting pin....Washer, nut and cotter pin.
Mobil 28 grease (red).
Side load fitting pin....Spacer installed.
Side load fitting pin....Washer and nut at forward end, nut tight.
Side load fittings....Installed with four bolts, nuts tight.
Brake on landing gear arm....Installed with four bolts, washers and nuts.
Nuts tight.
Axle nut....Washer, nut and cotter pin.
Wheel bearings....Mobil 28 grease (red).
Screwjack end fitting to upper side load strut....Bolt, washers (3), nut and cotter pin.
Mobil 28 grease (red).
Screwjack end fitting to screwjack sleeve....Bolt, washer, nut and cotter pin.
Nut backed off half turn from finger tight.
Mobil 28 grease (red).
Screwjack (male threads....Light coat of Aeroshell 17 grease (black)
Landing gear leg to gear door pushrod....Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Gear door pushrod inboard end rod end bearing....Check nut installed.
Gear door pushrod outboard end rod end bearing....Check nut installed.
Gear door pushrod to gear door fittings....Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Gear door fittings on gear door....Installed with four screws, nuts tight.
Gear door hinge to wing....Screws installed.
Gear door hinge....Tri-Flow oil.
Wheel well door hinge to fuselage....Screws installed.
Wheel well door hinge....Tri-Flow oil.
Pushrod fitting on wheel well door....Installed with four screws, nuts tight.
Lower inb'd wheelwell door pushrod rod end bearing....Check nut installed.
Lower inb'd wheelwell door pushrod to fitting on door..Clevis pin and cotter pin.
Tri-Flow oil.
Upper inb'd wheelwell door pushrod to fitting in fuse..Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Fuselage fitting for wheel well door pushrod....Installed with four bolts, nuts tight.

Junction of three wheel well door pushrods.......... Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Outboard wheel well door pushrod rod end bearing....... Check nut installed.
Outb'd wheel well door pushrod to screwjack sleeve....... Bolt, washer and safety wire.
Tri-Flow oil.

At main landing gear, right wing:

Aft main landing gear fitting.......... Installed with five bolts, nuts tight.
Mobil 28 grease (red).
Main landing gear leg to landing gear arm.......... Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to upper end of oleo shock absorber Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to lower end of oleo shock absorber Pin, washer, nut and cotter pin.
Mobil 28 grease (red).
Main landing gear leg to side load strut pin.......... Washer and nut.
Main landing gear leg to lower side load strut.......... Washer, nut and cotter pin.
Mobil 28 grease (red).
Lower side load strut to upper side load strut.......... Bolt, washer, nut and cotter pin.
Mobil 28 grease (red).
Upper side load strut to side load fitting pin.......... Washer, nut and cotter pin.
Mobil 28 grease (red).
Side load fitting pin.......... Spacer installed.
Side load fitting pin.......... Washer and nut at forward end, nut tight.
Side load fittings.......... Installed with four bolts, nuts tight.
Brake on landing gear arm.......... Installed with four bolts, washers and nuts.
Nuts tight.
Axle nut.......... Washer, nut and cotter pin.
Wheel bearings.......... Mobil 28 grease (red).
Screwjack end fitting to upper side load strut.......... Bolt, washers (3), nut and cotter pin.
Mobil 28 grease (red).
Screwjack end fitting to screwjack sleeve.......... Bolt, washer, nut and cotter pin.
Nut backed off half turn from finger tight.
Mobil 28 grease (red).
Screwjack (male threads.......... Light coat of Aeroshell 17 grease (black)
Landing gear leg to gear door pushrod.......... Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Gear door pushrod inboard end rod end bearing.......... Check nut installed.
Gear door pushrod outboard end rod end bearing.......... Check nut installed.
Gear door pushrod to gear door fittings.......... Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Gear door fittings on gear door.......... Installed with four screws, nuts tight.
Gear door hinge to wing.......... Screws installed.
Gear door hinge.......... Tri-Flow oil.
Wheel well door hinge to fuselage.......... Screws installed.
Wheel well door hinge.......... Tri-Flow oil.
Pushrod fitting on wheel well door.......... Installed with four screws, nuts tight.
Lower inb'd wheelwell door pushrod rod end bearing... Check nut installed.
Lower inb'd wheelwell door pushrod to fitting on door.. Clevis pin and cotter pin.
Tri-Flow oil.
Upper inb'd wheelwell door pushrod to fitting in fuse.. Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Fuselage fitting for wheel well door pushrod.......... Installed with four bolts, nuts tight.
Junction of three wheel well door pushrods.......... Bolt, washer, nut and cotter pin.
Tri-Flow oil.
Outboard wheel well door pushrod rod end bearing....... Check nut installed.
Outb'd wheel well door pushrod to screwjack sleeve....... Bolt, washer and safety wire.
Tri-Flow oil.

Engine Installation:

Engine mount installation:

Top left engine mount lug to firewall frame........................Installed with 4 bolts, nuts tight.
Three screws through backing plate
and fuselage side.
Top left engine mount lug to engine mount............................Bolt, washer and nut, nuts tight.
Bottom left engine mount lug to firewall frame.................Installed with 4 bolts, nuts tight.
Three screws through backing plate
and fuselage side.
Bottom left engine mount lug to engine mount.....................Bolt, washer and nut, nuts tight.
Top right engine mount lug to firewall frame......................Installed with 4 bolts, nuts tight.
Three screws through backing plate
and fuselage side.
Top right engine mount lug to engine mount..........................Bolt, washer and nut, nuts tight.
Bottom right engine mount lug to firewall frame...............Installed with 4 bolts, nuts tight.
Three screws through backing plate
and fuselage side.
Bottom right engine mount lug to engine mount...................Bolt, washer and nut, nuts tight.
Top left engine mount to engine..Lord mount, bolt, washer, nut and cotter pin.
Bolt torqued.
Bottom left engine mount to engine..Lord mount, bolt, washer, nut and cotter pin.
Bolt torqued.
Top right engine mount to engine..Lord mount, bolt, washer, nut and cotter pin.
Bolt torqued.
Bottom right engine mount to engine..Lord mount, bolt, washer, nut and cotter pin.
Bolt torqued.

Baffling installation:

Left front baffle assembly to engine crankcase..................Screws (2), washers and lock washers (2).
Rubber chafe-seals installed.
Left front baffle assembly to cylinder head........................Screws (2), washers and lock washers (2).
Left front baffle assembly to left aft baffle assy.............Clip, screws (2), washers (2) and nuts (2).
Left aft baffle assembly to cylinder head.............................Screws (2), washers and lock washers (2).
Ignition lead support on left aft baffle assembly.............Screws (2), washers (2) and nuts (2), nuts tight.
Left aft baffle assembly to engine crankcase.......................Bolt, washer and nut. (Type 1 and 2
Dynafocal only).
Rubber chafe-seals installed.
Left aft baffle assembly to right aft baffle assembly.....Clip, screws (2), washers (2) and nuts (2).
Aft center baffle bracket to engine crankcase......................Installed on engine studs and nuts.
Rubber chafe-seals installed.
Aft center baffle brket to left & right aft baffle assy....Screws (4), washers (4) and nuts (4).
Right aft baffle assembly to engine crankcase.....................Screw, washer and lock washer.
(Type 1 Dynafocal only).
Rubber chafe-seals installed.
Ignition lead support on right aft baffle assembly............Screws (2), washers (2) and nuts (2), nuts tight.
Right aft baffle assembly to cylinder head..........................Screws (2), washers and lock washers (2).
Right aft baffle assembly to right front baffle assy.........Clip, screws (2), washers (2) and nuts (2).
Right front baffle assembly to cylinder head......................Screws (2), washers and lock washers (2).
Right front baffle assembly to engine crankcase.................Screw, washer, and lock washer.
Rubber chafe-seals installed.
Left front baffle assembly to intercylinder baffles..........Springs (2).
Left aft baffle assembly to intercylinder baffles..............Springs (2).
Right front baffle assembly to intercylinder baffles.......Springs (2).
Right aft baffle assembly to intercylinder baffles...........Springs (2).
Left front baffle assembly to front oil cooler support....Screws (6), washers (6) and nuts (6), nuts tight.
Left front baffle assembly to aft oil cooler support.........Screws (4), washers (4) and nuts (4), nuts tight.

Exhaust system installation:

Exhaust pipe to left front cylinder...Lock washers (2) and nuts (2). Nuts tight.
Exhaust pipe to left aft cylinder...Lock washers (2) and nuts (2). Nuts tight.

Exhaust pipe to right front cylinder	Lock washers (2) and nuts (2). Nuts tight.
Exhaust pipe to right aft cylinder	Lock washers (2) and nuts (2). Nuts tight.
L.H. exhaust pipe support on firewall frame	Bolts (2), washers (2) and nuts (2). Nuts tight.
L.H. exhaust pipe support to exh'st pipe support straps	Grommet, bolt, large washers (2), washer, nut and cotter pin. Nut snug on rubber grommet.
L.H. exhaust pipe support straps to tailpipe clamp	Bolt, washer, nut and cotter pin.
R.H. exhaust pipe support on firewall frame	Bolts (2), washers (2) and nuts (2). Nuts tight.
R.H. exhaust pipe supp't to exh'st pipe support straps	Grommet, bolt, large washers (2), washer, nut and cotter pin. Nut snug on rubber grommet.
R.H. exhaust pipe support straps to tailpipe clamp	Bolt, washer, nut and cotter pin.

Cabin heat and alternator cooling systems:

Cabin heat Aeroduct tubing at right front baffle assy	Clamp installed and tight.
Cabin heat Aeroduct tubing at cabin heat muff inlet	Clamp installed and tight.
Cabin heat muff	Check installation.
Cabin heat muff outlet to Aeroduct tubing	Clamp installed and tight.
Cabin heat Aeroduct tubing to cabin heat valve	Clamp installed and tight.
Alternator cooling tubing at rgt front baffle assy	Clamp installed and tight on Aeroduct tubing.
Alternator cooling tubing at alternator	Clamp installed and tight on Aeroduct tubing.

Oil cooling system:

Engine accessory case to oil cooler supply line	Check
Oil cooler supply line to oil cooler	Check
Oil cooler to oil cooler return line	Check
Oil cooler return line to engine accessory case	Check

Propeller and spinner installation:

Propeller to engine crankshaft	Attachment studs (6) torqued and safetied.
Spinner mounting plate to propeller hub	Attachment bolts (4?) installed and tight.
Spinner to spinner mounting plate	Screws (how many?) installed and tight.

Cowling installation:

Top center cowling support to firewall frame	Screws (8), bolts (2), washers (2) and nuts (2).
Left cowling support to firewall frame	Screws (10), bolts (2), washers (2) and nuts (2).
Right cowling support to firewall frame	Screws (10), bolts (2), washers (2) and nuts (2).
Bottom left cowling support to firewall frame	Screw and bolt.
Bottom right cowling support to firewall frame	Screw and bolt.
Upper cowling to top center cowling support	Screws (9) into nutplates.
Lower cowling to cowling supports	Screws (14) into nutplates.
Upper cowling to lower cowling at the front	Screws (10) into nutplates.
L.H. cowling door hinge pin	Safetied into hole in cowling support. Tri-Flow oil.
R.H. cowling door hinge pin	Safetied into hole in cowling support. Tri-Flow oil.
L.H. cowling door wing fasteners	Check installation of fasteners (4). Tri-Flow oil.
L.H. cowling door wing fasteners receptacles	Check installation of receptacles (4). Tri-Flow oil.
L.H. cowling door	Smooth operation.
R.H. cowling door wing fasteners	Check installation of fasteners (4). Tri-Flow oil.
R.H. cowling door wing fasteners receptacles	Check installation of receptacles (4). Tri-Flow oil.
R.H. cowling door	Smooth operation.
Landing light to lower cowling	Ring and screws (3).
Wiring to landing light	Bonded in place.

Instrumentation:

Oil pressure line to engine accessory case	Check.
Oil pressure line to oil pressure transducer	Check.
Oil pressure transducer on engine mount	Installed securely.

Manifold pressure line to cylinder head....Check
Manifold pressure line at cabin heat valve assembly....Check.
Manifold pressure line, cabin heat valve assembly
to manifold pressure gauge....Check.
Tachometer angle drive to tachometer....Check.
Tachometer cable to tachometer angle drive....Check.
Tachometer cable at cabin heat valve assembly....Grommet installed.
Tachometer cable to engine accessory case....Check.

Fuel System:

Aft fuel tank:

Left aft tank support fitting to fuselage frame....Bolt, washer and nut. Nut tight.
Left aft tank support fitting to tank support strap....Clevis pin and cotter pin.
Right aft tank support fitting to fuselage frame....Bolt, washer and nut. Nut tight.
Right aft tank support fitting to tank support strap....Clevis pin and cotter pin.
Left front tank support fitting to fuselage frame....Bolt, washer and nut. Nut tight.
Left front tank support fitting to tank support strap....Clevis pin and cotter pin.
Right front tank support fitting to fuselage frame....Bolt, washer and nut. Nut tight.
Right front tank support fitting to tank support strap....Clevis pin and cotter pin.
Felt and rubber padding....Check.
Left tank support strap tension screw....Safety wired.
Right tank support strap tension screw....Safety wired.
Vent fittings and lines....Check.
Finger strainer....Check.
Fuel line....Check.
Aft tank sump fitting....Check.
Tank cap....Check.
Vent line open....Blow into cap opening and check air out of vent.

Inverted header tank:

Front tank support straps to fuselage....Installed with 3 screws per strap.
Aft tank support straps to fuselage....Installed with 3 screws per strap.
Felt and rubber padding....Check.
Front tank support strap tension screw....Safety wired.
Aft tank support strap tension screw....Safety wired.
Vent return check valve....Ball installed.
Flop tube....Check.
Vent return line and fittings....Check.
Fuel lines....Check.

Front fuel tank:

Left aft tank support fitting to fuselage....Bolts (2), washers (2) and nuts (2). Nuts tight.
Left aft tank support fitting to tank support strap....Clevis pin and cotter pin.
Right aft tank support fitting to fuselage....Bolts (2), washers (2) and nuts (2). Nuts tight.
Right aft tank support fitting to tank support strap....Clevis pin and cotter pin.
Left front tank support fitting to fuselage frame....Bolts (2), washers (2) and nuts (2). Nuts tight.
Left front tank support fitting to tank support strap....Clevis pin and cotter pin.
Right front tank support fitting to fuselage frame....Bolts (2), washers (2) and nuts (2). Nuts tight.
Right front tank support fitting to tank support strap....Clevis pin and cotter pin.
Felt and rubber padding....Check.
Left tank support strap tension screw....Safety wired.
Right tank support strap tension screw....Safety wired.
Vent fittings and lines....Check.
Finger strainer....Check.
Fuel line....Check.
Front tank sump fitting....Check.
Fuel selector valve....Check.
Tank cap....Check.
Vent line open....Blow into cap opening and check air out of vent.

Engine compartment:

Fuel line, firewall to gascolator .... Check.
Fuel line, gascolator to electric fuel pump .... Check.
Fuel line, electric fuel pump to engine-driven fuel pump Check.
Fuel line, engine-driven fuel pump to injector throttle body Check.
Fuel line, injector throttle body to spider .... Check.
Fuel lines (4), spider to injectors .... Check.
Fuel pressure line, spider to firewall fitting .... Check.
Fuel pressure line, firewall to fuel pressure gauge .... Check.

Cleaning fuel system lines:

The fuel system lines must be clean before the first flight. Disconnect the fuel line from the engine-driven fuel pump and use the electric pump to pump fuel from each tank into a bucket. Remove and clean the strainer in the gascolator. Since the bucket isn't likely to be spotlessly clean, dump the fuel into your car's tank rather than recycle it. Repeat the process until the strainer is clean.

Seats Installation:

Pilot's R.H. seat track to fuselage .... Bolts (3), washers (3) and nuts (3). Nuts tight.
Pilot's L.H. seat track to fuselage .... Bolts (3), washers (3) and nuts (3). Nuts tight.
Pilot's seat to seat tracks .... Rubber washers (4), washers (4) and nuts (4).
Pilot's crotch strap support .... Installed between front seat support studs.
Passenger's R.H. seat track to fuselage .... Bolts (3), washers (3) and nuts (3). Nuts tight.
Passenger's L.H. seat track to fuselage .... Bolts (3), washers (3) and nuts (3). Nuts tight.
Passenger's seat to seat tracks .... Rubber washers (4), washers (4) and nuts (4).
Passenger's crotch strap support .... Installed between front seat support studs.
Pilot's shoulder belt support fitting to fuselage .... Screws (3), washers (3) and nuts (3). Nuts tight.
Pilot's shoulder belt clips to support fittings .... Bolt, washer, nut and cotter pin.
Pilot's shoulder belt to clips .... Bolt, washer, nut and cotter pin.
Passenger's shoulder belt support fitting to fuselage .... Screws (3), washers (3) and nuts (3). Nuts tight.
Passenger's shoulder belt clips to support fittings .... Bolt, washer, nut and cotter pin.
Passenger's shoulder belt to clips .... Bolt, washer, nut and cotter pin.
Pilot's outboard seat belt fitting to fuselage .... Bolts (4), washers (4) and nuts (4). Nuts tight.
Pilot's outboard seat belt fitting to seat belt cable .... Bolt, washer, nut and cotter pin.
Pilot's outboard seat belt to seat belt cable .... Bolt, washer, nut and cotter pin.
Pilot's inboard seat belt to seat belt cable .... Bolt, washer, nut and cotter pin.
Pilot's inb'd seat belt cable to inb'd seat belt fitting .... Bolt, washer, nut and cotter pin.
Passenger's outboard seat belt fitting to fuselage .... Bolts (4), washers (4) and nuts (4). Nuts tight.
Passenger's outb'd seat belt fitting to seat belt cable .... Bolt, washer, nut and cotter pin.
Passenger's outboard seat belt to seat belt cable .... Bolt, washer, nut and cotter pin.
Passenger's inboard seat belt to seat belt cable .... Bolt, washer, nut and cotter pin.
Pass'ger inb'd seat belt cable to inb'd seat belt fitting .... Bolt, washer, nut and cotter pin.
Pilot's seat track .... Smooth operation.
Latch working properly?
Tri-Flow oil.
Passenger's seat track .... Smooth operation.
Latch working properly?
Tri-Flow oil.

Windshield and Canopy Installation:

Windshield installation .... Check.
Canopy on canopy frame .... Check.
Left canopy track .... Installed with 4 screws.
Left canopy roller assembly in canopy track .... Four rollers.
Tri-Flow oil.
Smooth operation.
Left canopy roller assembly to canopy frame .... Bolts (2) and nuts (2).
Left aft canopy roller support to fuselage .... Screws (3).
Left aft canopy roller support to lower roller .... Screw, washers (3) and nut. Nut tight.

	Smooth operation.
Left aft canopy roller support to upper roller	Screw, washers (3) and nut. Nut tight.
	Smooth operation.
Left aft canopy stop bolt in canopy track	Bolt, washer, nut.
Right canopy track	Installed with 4 screws.
Right canopy roller assembly in canopy track	Four rollers.
	Tri-Flow oil.
	Smooth operation.
Right canopy roller assembly to canopy frame	Bolts (2) and nuts (2).
Right aft canopy roller support to fuselage	Screws (3).
Right aft canopy roller support to lower roller	Screw, washers (3) and nut. Nut tight.
	Smooth operation.
Right aft canopy roller support to upper roller	Screw, washers (3) and nut. Nut tight.
	Smooth operation.
Aft center canopy roller in canopy frame	Bolt and nut.
	Smooth operation.
Dorsal fin tube forward end fitting to fuse bracket	Screw, washer and nut. Nut tight.
Dorsal fin tube forward end bracket to fuselage	Screws (2), washers (2) and nuts (2). Nuts tight.
Dorsal fin tube aft end fitting to dorsal fin	One screw installed.
Aft center canopy pin fitting to fuselage	Screws (2), washers (2) and nuts (2). Nuts tight.
Canopy frame pin to aft center canopy pin fitting	Smooth operation.
Canopy latch to windshield bow	Screws (5).
Canopy latch handle to canopy frame	Clevis pin and cotter pin.
	Tri-Flow oil.
Canopy latch handle to canopy latch hook	Bolt, washer, nut and cotter pin.
	Tri-Flow oil.
Canopy frame pin into canopy latch hole	Smooth operation.
Canopy latch mechanism	Proper, over-center locking action.
	Smooth operation.
Canopy skirt fairing	Clearance with fuselage.

Miscellaneous:

Fuselage to tail section	Bolts (12), washers (24) and nuts (12).
	Nuts tight.
Instrument panel to fuselage frame	Washers (8) and nuts (8). Nuts tight.
Instrument panel to center console panel	Bolts (2).
Center console panel to fuselage floor	Screws (3).

Pitot-static system
Wheels balanced?
Vacuum system
Access panels installed.

Electrical System Equipment Installation:

In addition to the electrically operated gear and flaps, all components of the electrical system should be ground tested for proper operation. Many components can be tested on the battery alone, but ensure that the battery is completely recharged prior to the first flight. The electrical system is complex and the more familiar you are with the system, the less problems you will encounter. Ideally, each sub-system in the electrical system should have been tested during construction. You have a lot of work in store, for example, if you have to remove the instrument panel to trouble-shoot a problem in the system after assembly.

At engine compartment:

Alternator installation and belt tension	Check
Oil pressure transducer on the engine mount	Check
Oil temperature sender on the engine	Check
Cylinder head temperature sender on the engine	Check
Fuelgard transducer on the firewall or engine mount	Check
Electric fuel pump on the firewall	Check
EGT thermocouples on the exhaust pipes	Check
Ldg gear down limit switch on nose gear lwr drag strut	Check.

Landing gear up limit switch on the firewall.........................Check.
Landing light on the lower cowling...Check.
Ignition harness..Check.

Frame No. 1, aft face:
Alternator shunt...Check.
Fuse holder...Check.
Alternator analyzer transducer...Check.

Front fuel tank:
Fuel quantity sender..Check.

Glare shield:
Four glare shield lights..Check.

Frame No. 3:
Compass (internally lighted)..Check.
OAT probe on right fuselage skin, fwd of the frame........Check.

Center console panel:
Flap position switch...Check.
Throttle position switch..Check.
Landing gear warning horn...Check.

Control sticks:
Microphone push-to-talk switches..Check.

Center console cover:
Alternator analyzer gauge..Check.

Frame No. 4:
Autopilot roll servo in right wing..Check.

Frame No. 5:
Terminal block ....Check.
Landing gear up relay...Check.
Landing gear down relay..Check.
Fuse holder on forward face of frame.....................................Check.

Frame No. 6:
Master relay..Check.
Starter relay...Check.
Strobe power supply..Check.
Ammeter shunt...Check.
Fuse holder...Check.
Terminal block..Check.
Main negative bus bar on bottom floor.....................................Check.
Voltage regulator...Check.
Starting vibrator (if required for engine...................................Check.
DME or RNAV receiver..Check.
Carburetor ice detector (optional...Check.
Marker beacon receiver...Check.
Altitude encoder...Check.

Aft fuel tank:
Fuel quantity sender..Check.

Battery compartment:
Battery (Gill PS6-11 or Gel/Cell U-128.................................Check.

Front fin spar

Loran antenna coupler .... Check.
Terminal block for tail light wires and loran antenna .... Check.

Rudder:

Tail light .... Check.

Wing:

Wing tip lights .... Check.
Heated pitot .... Check.

Electrical System Operation Before Engine Start:

Check the operation of the following electrical circuits or devices using battery power:

Master switch .... Check.
Fuel pump .... Check.
Pitot heat .... Check.
Turn and bank .... Check.
Strobe lights .... Check.
Navigation lights .... Check.
Landing light .... Check.
Gear actuation circuit .... Check.
Gear indication circuit .... Check.
Flap circuit .... Check.
Panel light circuits and dimmers (2) .... Check.
Instrumentation?. .... Check.
Voltmeter .... Check.
Ammeter .... Check.
Fuel quantity front tank .... Check.
Fuel quantity aft tank .... Check.
Clock-Timer .... Check.
Audio circuit .... Check.
Intercom .... Check.
Outside air temperature .... Check.
Com 1 .... Check.
Com 2 .... Check.
Nav 1 .... Check.
Nav 2 .... Check.

Retraction System Operation:

L.H. side load arm down and over-center .... Kick test.
R.H. side load arm down and over-center .... Kick test.
Nose gear drag struts down and over-center .... Kick test.
Proper adjustment of the gear .... Check.
Nose gear screwjack end fitting .... Check free to move against spring.
Nose gear screwjack .... Clean of dirt.
Light coat of Aeroshell 17 grease (black).
Left main gear screwjack end fitting .... Check free to move against spring.
Left main gear screwjack .... Clean of dirt.
Light coat of Aeroshell 17 grease (black).
Right main gear screwjack end fitting .... Check free to move against spring.
Right main gear screwjack .... Clean of dirt.
Light coat of Aeroshell 17 grease (black).
Throttle position switch .... Check.
Flap position switch .... Check.

With the aircraft on jacks, cycle, adjust and test the landing gear retraction system in both the normal (electrical) and manual operation. Simulate about 20 lb. air load on the nose gear tire with your hand. All limit switches, indicators and warning lights should function as designed. The jumper must be installed for these tests.

It is essential that each screwjack be extended enough so that the springs are compressed. The screwjack end fittings have a 10mm (.39") stroke. It is a good idea to mark the end of the stroke so that you can tell at a glance how far the system is "into the spring." It is also essential that you be able to determine from the cockpit that the system is working properly in the air. Thus, you should cycle the landing gear to the down position and then count the number of turns required to end up "fully compressed" on the springs. With 10 threads per inch, the screwjacks advance .100" per revolution, thus the compression of the spring requires 3.9 turns of the handle. Memorize this figure. Once the airplane is flying, you can easily determine if your retraction system is extending the screwjacks enough to compress each spring.

After the ground cycle tests are complete, remove the jumper. Since Murphy's Law applies to landing gear, you should disengage the landing gear motor by pulling the knob up until you intend for the system to retract the landing gear.

Brake System Operation:

Brake reservoir..Full.
Left brakes..Bleed.
Right brake..Bleed.
Left brake..Working.
Left brake with parking brake valve on..Working.
Right brake..Working.
Right brake with parking brake valve on..Working.

Chapter 2
Flight Testing

The Test Pilot

Who will be the pilot on the first flight? There are two ways to make the decision: one based on logic and one based on emotion. The emotional decision is the wrong one.

You should always be prepared for the worst. Imagine this worst case scenario: the Falco takes off, and it is obvious that one wing is "heavy" requiring a hefty sideways push on the stick. The engine gauges start to go up rapidly and are quickly above the red line. Smoke starts to fill the cockpit—an electrical fire! The engine begins to run roughly and then coughs, sputters and stops. Who should be flying the Falco in a situation like this? Obviously, a pilot who could handle this situation. But for reasons based mainly on emotion, most homebuilders appoint themselves to be the pilot!

Allowing someone else to fly your homebuilt airplane for the first time is a difficult thing for many homebuilders to accept. There seems to be a compulsion to be the first to fly the airplane, even though the homebuilder has spent little time flying recently and has no experience flying an airplane like the Falco. Get smart. Think! Base your decision on logic only. Allowing someone to fly your plane is *not* like allowing someone else to spend the wedding night with your bride!

Who should be the pilot? You want an extremely experienced pilot. Someone who has flown a lot of different types of aircraft, preferably aircraft with light controls. It's best if the pilot has flown a Falco, but other similar aircraft are the SF.260, the CAP-10, the Pitts and the Christen Eagle. If the pilot does not have time in a Falco, look into getting some time in one—Falco owners are usually willing to help out in things like this. Pilots with experience in military jet fighters *and with extensive experience in light aircraft* are normally capable of handling an airplane like the Falco with little difficulty. Beware of military or airline pilots without extensive experience with light aircraft—their record is poor.

If this sounds like excessive caution, consider this. Of all the fatalities involving homebuilt aircraft each year, roughly *10-20% of the total occur on the very first flight*. The pattern is well-established: the builder has not kept up his flying skills but flies the airplane anyway; climbing oil temperatures or other difficulties distract the pilot and he fails to maintain control of the airplane. If you stall the airplane at low altitude, you are virtually assured of dying.

In a study of 1981 accidents involving homebuilts, nearly half of the stall/spin accidents were homebuilts being flown for the first time. Presumably, the pilots at the stick were flying that type airplane for the first time as well. If it takes all of a pilot's concentration just to keep flying with the wings level, he won't have the brain cells left over to notice the engine gauges, etc. If you do not qualify as an experienced pilot capable of handling the worst, don't appoint yourself to be the pilot. It is much more important that the first flight go safely and that you have years of flying the airplane.

A note to the test pilot: if you are asked to do the initial test flights of a Falco, we think it's only prudent to insist that the airplane be checked out by a practicing A&P mechanic. In other words, the mechanic should be one who works on aircraft every day—not just someone who has the rating—and he should have used the check list from Chapter 1. Ask to have the mechanic there at the time of the first flight to make adjustments. Get him off by himself and ask him what he thinks of the plane.

Flight Test Philosophy

Military test pilots are chosen for their flying skills, quick reactions, good vision, understanding of the mechanics of an airplane, their experience and ability to relate the results of a test to the accomplishment of the mission of the aircraft. By the time they reach the Test Pilot School, most have matured from the cocky infallibility of the beginner. They have all had friends who have died in airplanes. They have come to respect the inherent danger of their work and the horrible price of a mistake.

On one hand, these men would rather fly jet fighters than do almost anything else—but they have also been to the funerals of fellow pilots. They have consoled the wife and children of a friend whose body is now an unrecognizable cinder mercifully concealed in an attractive wooden casket. And they have had that long, silent ride home with their own family with everyone wondering who will be next.

So there may be some truth to the popular image of test pilots and their bravado, but more likely it's a way of dealing with the sometimes-grim reality of flying. They may all love flying, but they also want very much to stay alive. It's easy to get a Navy carrier pilot to admit that he would probably do the same work for no flight pay, but on night instrument approaches their blood pressure, nervous tension, and perspiration reach some of the highest levels ever recorded by medical instruments. "Piece o' cake!" he'll tell his buddies—as he quietly sneaks off for a change of underwear.

At the Test Pilot School they learn the methods that have been developed over the years to test new aircraft. If you are going to test the airplane, put aside all notions of test pilot bravado, and mentally put yourself in the sober frame of mind of a seasoned test pilot. And practice the methods used by trained test pilots.

Test pilots are taught to "plan the flight and fly the plan." Each flight has a specific purpose—give a lot of thought to the plan and don't deviate from it. There has to be a purpose for everything you do, and you don't do anything that there is no need for. Many accidents occur when a test flight is going according to plan, and then the pilot later reports that "everything was going so well" that he deviated from the plan and got into trouble.

If you watch a test pilot work, you will be struck by the careful, plodding, methodical approach to every flight. He will spend much more time thinking and planning than he will flying the airplane. The pilots are schooled in the methodical, purposeful approach. You test one thing at a time in the safest possible manner. You test things in the most logical order.

Conduct all of the flight tests in a building block fashion—adding to your knowledge of the airplane in distinct, methodical steps. *Never proceed to the next test until you are satisfied with the last one!*

Keep careful records. Have a clipboard ready for every flight. Write down a list of tests to be performed on each flight and check them off as each is accomplished. Record all things that have to be fixed. Date and keep each report. Note the flight conditions—wind, air temperature, etc—for each flight. Note the engine instrument readings. But remember, "Aviate, navigate, then communicate." Don't get so engrossed in taking notes that you forget to fly the aircraft.

The typical flight test team consists of the test pilot and a flight test engineer, who works closely with the pilot to plan and evaluate each flight. Sometimes the pilot is not up for flying, and the engineer can call the flight off for another day. Sometimes the pilot should be left alone to sit quietly and compose his thoughts before starting the engine. The flight engineer must sense this and know what to do.

But if you are flying an airplane for a homebuilder, you will not have a flight engineer to orchestrate a calm situation. You are in the process of flying the proud homebuilder's creation, and because of his enthusiasm he is probably going to be a complete pest. Explain the need for peace and quiet, and politely inform your garrulous proud-as-a-peacock builder that the Father's Waiting Room is... over *there*.

Flight testing is considered to have three levels: development, engineering and production. Development flight testing includes the initial flight tests of a new design and all tests to open the flight envelope. This includes a whole range of stall tests, spin tests, high speed dive tests and flutter tests. Engineering flight validates data but does not expand the envelope. Performance testing is an example. Production flight testing confirms that aircraft coming off an assembly line conform to the characteristics of the design.

The initial flight test of a Falco includes elements of all three levels. Production aircraft are built in precision jigs and all basically identical. The same cannot be said of homebuilt aircraft. Experience has shown that homebuilt aircraft are sometimes out of rig. (We can think of two examples. One was a single place Pitts, which exhibited positive instability in pitch—it would do an automatic snap roll on an entry to a normal turn. One expert pilot termed it "the most dangerous airplane I ever flew" and considered himself lucky to have lived through the flight. The second was a beautifully built Osprey II amphibian, which was out of rig and killed an experienced test pilot on the first flight.) For this reason, we advocate using some development flight test procedures, such as the controls authority tests, which would never be done for normal production aircraft.

In the flight test business there are two schools of thought on high speed taxi tests: one says do them with the intent to get airborne briefly and the other says don't. We agree with the latter. The problem is that the "airborne" part of the high speed taxi test is too ill-defined—is the intent to fly or to land? Even minor control inputs may result in much greater than expected results—a likely event with a new-to-the-Falco pilot—and this maneuvering is not a good thing to be doing at 2' to 5' in the air.

Homebuilders have long proved that, with a reasonable CG location, almost *anything* will fly. Problems show up most oftenly at the "edges" of the flight envelope—at the slowest and fastest speeds. Thus, the slowest and fastest speeds should be treated as danger zones to be avoided. Landings and takeoffs can—and initially *should*—be done at speeds *above* the stall speed to avoid the danger. The object of the first takeoff is to insert yourself firmly into the middle of the flight envelope so that you can safely explore the ragged edge of the stall after you have lots of altitude.

Many homebuilders think it's a good idea to skittle along the ground and feel out the controls of the airplane—something few of them are able to do well in *any* airplane. Not to mention an unfamiliar airplane. With much more sensitive controls. With unknown bad handling characteristics. And a tail-dragger in many cases! It's a set up for a disaster.

Interestingly, the first flight of the General Dynamics F-16 was a high speed taxi test that got out of hand. The aircraft actually lifted off, and the test pilot realized his controllability was very poor—remember the F-16 has fly-by-wire controls and the handling had not yet been properly programmed into the computer. The aircraft began a tail heavy wing-rocking-nose-bobbing pilot-induced-occilation. The pilot fought for control of the aircraft while still close to the ground and finally decided the only safe thing to do was to fly the aircraft up away from the ground. He hit the afterburner, climbed out and once he had altitude he had time to think, check things out and learn how to fly the aircraft. While the aircraft was controllable in a clean configuration, it was almost uncontrollable with the gear and flaps down. As a result, he bellied the airplane in on the grass beside the runway.

Thus, if you do high speed taxi tests at all, they should be done with the specific purpose to check the controls effectiveness, ground handling, engine power, and familiarization with handling on initial takeoff roll. Do not get airborne!

Statistically, the first minute after brake release represents one of the most significant "risk windows" in all of flying, and engine stoppages frequently coincide with power changes. The Falco's Lycoming engine may be flown at full throttle indefinitely, so there's no good reason to reduce power except to conserve fuel. Our strong recommendation is that you do not reduce the throttle or propeller RPM setting until you have sufficient altitude to safely glide to a landing in the event of a complete power failure. This is for normal flights. For the first several flights, our strong recommendation is that you do not reduce the throttle or propeller RPM until you have at least 3,000 feet of altitude over the airport.

Statistics show that engine failures (particularly from fuel system problems) are far and away the greatest cause of accidents on the first flight of homebuilt aircraft. Thus, you should fly the airplane as though the engine will quit at any time. *Never get yourself into a position where you must depend on the engine to land safely!* Keep your speed up. Circle over the airport. Keep within gliding distance at all time—and that means close to the airport since the Falco descends *extremely* steeply with the gear and flaps down and the engine off.

The Handling Characteristics of the Falco

If you have never flown a Falco before, a few words are in order. The Falco, as designed, has no bad habits, but it is a responsive, sensitive aircraft. If you are a low- to medium-time pilot, you have absolutely no business doing the initial test flights in the Falco. The Falco is an exciting aircraft to fly, and you are in for a certain amount of "handling shock" if you have been flying ordinary production aircraft. The controls are light and responsive, and it is normal for pilots to overcontrol the Falco on the first flight. Once you become used to the Falco, you can expect to fly it effortlessly, and you will not have to think about how much pressure to put on the stick to fly it.

The Falco is a "fingertip" airplane. The first sign of over-controlling the Falco is when a pilot takes the stick in his hand, or—more accurately—his clenched fist. With the Falco, you never need anything more than your thumb and two fingers. Those three fingers are good for takeoff, landing, cruise and all acrobatic maneuvers.

The key to flying the Falco is to *rest your arm on your leg and fly the Falco with movements of your fingers and wrist—not* movements of your arm. Burn this in your memory, and you will be a long way toward flying a Falco well. Use this technique for all of your control inputs during high speed taxi tests, and you will develop the habit and feel of flying a Falco. Remember: your arm goes on your leg, and use movements of your fingers and wrist. You only need to move the stick an inch or so in any direction for normal maneuvers. The Falco is nothing to be afraid of—it is just an airplane that is flown with a light touch.

The best technique for takeoff is to begin to feed in some back-pressure on the stick once the takeoff roll has begun. As the elevator begins to take effect, keep increasing the back-pressure until the nose starts to come up. Ideally, you will arrive at takeoff speed just as the nose reaches the nose-high attitude for takeoff, and the Falco will fly off.

Try to burn this attitude and view from the cockpit into your memory for when you land. You can expect to flare too high on the first few landings. It's best if you have a good mental picture of where you will be when the tires hit the runway.

The best landing technique is to maintain some power until you touch down—the elevator is more effective with some extra wind from the propeller. Round out from the approach and let the airplane down slowly to the runway. If you don't keep some power on, the airplane is likely to stall and drop on. Remember to use the same light fingertip touch on the stick while you land.

The trailing link main gear is soft and very forgiving of a bad landing. The nose gear will have a tendency to fall through on a landing. Just like on the takeoff roll, it's a good idea to keep most of the weight on the mains, so keep some stick back-pressure during the roll out.

Many pilots find the nose wheel steering much too sensitive, and initially they overcontrol the Falco on the ground. With Beech/Piper/Cessna aircraft, a slight change in taxi direction requires a distinct *shove* on the rudder pedal—you stomp your foot into it with a motion sufficient to get a bicycle under way!—and the pedal must *move* before the airplane will change direction. With the Falco, it's not like that at all. It's best to think in terms of changes of pressure on the rudder pedal, not movement. To make a slight turn, just press a little harder, and don't expect the rudder pedal to move. If taxiing a Piper is like walking in sand, then the Falco is like walking on a polished floor. As with everything about the Falco, you must make the transition from mushy controls to precise, responsive controls—and once you get used to it you never want to go back.

Many aircraft are flown with constant changes to the elevator trim, but not the Falco. Most Falco pilots set the trim for cruise and do not touch the trim during the descent, approach and landing—and they use the same setting for takeoff and initial climb. For the first flight, set the trim at exactly neutral (with the tab directly aligned with the elevator) or slightly nose-down (with the trailing edge of the tab about 3mm above the trailing edge of the elevator). These would be typical cruise settings, so you should expect to have to hold some back-pressure on the stick during the initial climb. The pressures are light, and most Falco pilots don't bother to adjust the trim during the initial climb. Once you establish the airplane in an extended cruise-climb, you will probably want to trim the elevator, but typically you would not touch the trim until that time.

It is essentially impossible to slow the Falco to landing gear speed while in a descent, thus you must level off, ease back on the throttle and wait until the speed drops off. Once the gear is extended, speed control is very easy.

The Falco has a "dual personality." In normal cruising configuration, it is an exceptionally clean airplane, and it will pick up speed rapidly in a dive. When the gear and flaps are lowered, the entire nature of the airplane changes. The controls remain the same—light and effective right down through the flare—but the Falco is suddenly very dirty. It takes a fair amount of power to maintain altitude, and when you reduce power the airplane will descend rapidly.

The rate of descent gets rather spectacular when you select full flaps (45°) with the power off, so we suggest you use no more than 20° of flaps for the first few landings. Typically, full flaps are used only when you have the runway made. Full flaps on the Falco make steep approaches and precision landings easy, but they produce so much drag that they should be used with extreme caution until you are thoroughly familiar with them. A nose gear door adds greatly to the drag and should not be installed until you are completely comfortable with the Falco.

The ailerons are effective right down into a full stall, but you can expect one wing to drop rather quickly when the plane stalls. The Falco is sensitive to lateral loading, and the airplane will probably fall off on the left wing with only one person on board. Recovery is immediate with a decrease in the angle of attack. This immediate recovery from a stall also makes it very easy to get into a secondary stall. You can be tempted to pull out of the dive prematurely—it's just a perfect set-up for a high speed stall. Watch out. This is one way the Falco will bite you!

With properly adjusted stall strips, the Falco gives a good warning, but you have no reason to expect this warning until it is proved for your aircraft. Properly adjusted stall strips will produce a pronounced buffet prior to—and during—a stall. Current certification requirements (FAR 23.207) require that an aircraft give some sort of warning between five and ten knots before the stall, obtained by doing a gradual one-knot-per-second speed reduction, and—after releasing back pressure as soon as the nose begins to drop—the wing and nose drop should not exceed 15° and the altitude loss should not exceed 150 feet. The stall strips must be individually adjusted for each aircraft: to increase the stall warning, the stall strip should be raised or enlarged.

If you get into an unintentional spin, the Falco will recover quickly using the commonly-taught techniques, but we suggest you use the Beggs method of spin recovery, which is: Cut the throttle, take your hand off the stick, kick *full* opposite rudder until the spin stops, then neutralize rudder and pull out of the dive. (For a more complete discussion, see the section on spin testing below.)

Starting Engine for the First Time.

The cowling should be removed for the first engine start. For one thing, there is some risk that fuel or oil lines may not be completely tight. A leak could start a fire, which would be easier to extinguish if the cowling is off. In addition, you will be able to visually inspect the engine compartment while the engine is running. There's no telling what might be loose, so one of the objectives of the initial engine start is to see if anything is vibrating freely in the engine compartment. Use extreme caution while checking; the engine will be running and swinging a deadly propeller. Place *no* part of your body forward of the engine rear accessory case.

Remove the right seat, center console covers, the luggage compartment floor and aft cockpit bulkhead so that you may inspect the fuel lines and fittings for leaks. One Falco builder found his aft fuselage filled with gasoline. If everything is exposed, you will be able to quickly spot any such problems.

Remember how little of your specific aircraft has been proved to work as designed. Despite your best efforts and faultless workmanship, you have not actually proved that anything related to the engine actually works. You can see that the engine controls are operating properly, but there is the possibility that something is still hooked up incorrectly. The likelihood of something disastrous is small, but you should operate on the premise that any of the following things might happen:

- The engine will catch on fire.
- The propeller will throw a blade.
- The brakes will not work at all.
- The landing gear motor will start to retract the gear.
- The alternator will produce excessive voltage and damage the radios.
- The throttle control will not work properly, causing the engine to run at full power only.
- The chocks will not work, and the aircraft will speed forward uncontrollably—no steering or brakes.
- Neither the mixture control or ignition switch will cut off the engine.

Murphy's law—"If something can go wrong, it will"—was written for just such an event, so be on guard for the worst possible scenario.

As a precaution against an engine fire, have two safety observers standing near each wing tip (not in front of the aircraft) with appropriate fire extinguishers. The canopy should be open and the seat belts unfastened for a quick exit in the event of a fire. Because of the risk of fire, you should wear a flame-resistant Nomex flight suit if one is available.

Rehearse the signals with your ground crew for "okay", "higher rpm", "lower rpm", "shut down engine", "shut off ignition", "shut off mixture" and "shut off fuel". Rehearse the engine fire drill with the ground crew. The normal engine fire drill is:

Fuel selector valve....................Off.
Throttle....................Full open.
Master switch....................Off.
Ignition switch....................Off (after engine stops).

This technique assumes that gasoline is burning and that the best technique is to use up the fuel by running the engine. The blast of air from the propeller might blow out the flame, but it will also make it impossible to extinguish the flame with the fire extinguishers. If the ground crew calls for shutting down the engine before the fire is extinguished, shut off the mixture and ignition switch. When the engine has stopped running, get out of the airplane quickly.

The area should be clear so that a thrown propeller blade or runaway Falco will not do any damage. You know where a thrown blade will go, but have you considered where the second blade might be thrown? Remember, the airplane will be vibrating wildly and may move around a lot. The aircraft should be chocked *and* tied down to the tie-down points. Consider removing most or all radios until the electrical system is known. On the first flights, install only the essential radios. If an unfortunate mishap occurs and the aircraft is damaged, the expensive radios would not be lost.

If the engine controls fail to work, be prepared to pull the mixture to full lean and turn the ignition off immediately. And it *that* doesn't work, be prepared to turn the fuel selector valve off.

If your engine is a freshly-overhauled engine, see "Special Considerations for Overhauled Engines" below before proceeding. If your engine has not run in a long time, observe the pre-oiling precautions stated in Lycoming Service Instruction No. 1241—remove the top spark plugs and turn the engine with the starter, mixture in idle cutoff, until *at least 20 psi of oil pressure* registers on the gauge, then reinstall the plugs.

Ground Pre-Start Check

Ignition switch....................Off (remove key)
Engine cowling....................Removed.
Wheels....................Chocked.
Aircraft....................Tied down.
Fire extinguishers....................Available.
Front fuel tank....................Check fuel level.
Front fuel tank....................Cap secure.
Front fuel tank sump....................Drain water.
Landing gear, L.H....................Check tire pressure.
Landing gear, L.H....................Check oleo strut pressure.
Engine, left side....................Check condition, leaks, etc.
Brake reservoir....................Check fluid level.
Nose gear....................Check tire pressure.
Nose gear....................Check oleo strut pressure.
Oil cooler....................Check condition.
Propeller and spinner....................Check condition.
Alternator belt....................Check condition and belt tension.
Alternator wiring....................Check condition.
Engine, right side....................Check condition, leaks, etc.
Oil level....................Check.
Induction filter and system....................Check condition.
Gascolator....................Drain water.
Landing gear, R.H....................Check tire pressure.
Landing gear, R.H....................Check oleo strut pressure.
Battery door....................Closed.
Aft fuel tank....................Check fuel level.
Aft fuel tank....................Cap secure.
Aft fuel tank sump....................Drain water.

Cockpit Pre-Start Check

Seats .... Adjusted.
Seat belts .... Do not fasten (for quick exit).
Canopy .... Open (for quick exit).
Landing gear switch .... Down.
Landing gear motor .... Disengaged—pull knob up.
Parking brake .... On
Fuel selector .... Front.
Avionics .... Off.
Alternator switch .... Off.
All circuit breakers .... Pulled to "off" position.
All switch-type circuit breakers .... To "off" position.
Alternator field circuit breaker .... On.
Aux circuit breaker .... On (for the starter switch).
Instrumentation circuit breakers (2) .... On.
Master switch .... On (the green indicator light should come on).
Voltmeter .... Check battery voltage.
Ground crew .... Rehearse signals for "shut down" and "okay".

Engine Starting Procedure (Injected Engines)

(See F.8L Falco Flight Manual for starting procedures for carbureted engine.)

Alternate air .... Off.
Throttle .... Advance 2" (?).
Propeller RPM .... Full increase.
Mixture .... Full rich.
Auxiliary fuel pump .... On until fuel pressure stabilizes (4-5 sec), then Off.
Mixture .... Full lean.
Throttle .... Advanced 1/4" (?).
Fire extinguishers .... At the ready.
Clearance to side of propeller and in front of aircraft .... Everyone out of the way—"Clear prop!"
Ignition switch .... Start (release when engine starts).
Mixture (after engine fires) .... Full rich.
(Advance mixture at moderate rate—about 1 second. Too rapid enrichment can choke engine.)
Throttle (after engine starts) .... Retard to 800 RPM.
Oil pressure gauge .... Minimum pressure indication within 30 seconds.
If not, then shut the engine down.

Ground crew check .... Everything okay?—thumbs up?
Fuel pressure .... Green sector.
Manifold pressure gauge .... Indicating.
Tachometer .... Indicating.
Ammeter .... Indicating on – side.
Throttle control .... Idle-1200 RPM (forward-faster, back-slower).
Prop control .... Exercise to low rpm position.
Suction gauge .... Indicating.

Throttle .... 1000-1200 RPM
Ground crew check .... Everything okay?—thumbs up?
Oil temperature gauge .... Indicating.
CHT gauge .... Indicating.

Alternator switch .... On.
Ammeter .... Indicating on + side.
Alternator amps .... Indicating load on alternator.
Voltmeter .... Indicating 14 volts.

Run the engine for about 5 minutes, until the engine warms up and indicates some oil temperature and CHT. Stop the engine and inspect for fuel and oil leaks. Note and fix all discrepancies before going on to the next test.

Perform several engine run-ups with the cowling off. When everything is working well, replace the cowling and use the final inspection checklist to check the cowling and engine installation one last time. With the main wheels still chocked—the aircraft can now be untied—run the engine with the cowling installed, following the same procedure as listed above. Remember: the only new thing is the cowling. Check the cowling carefully, and note the cooling of the engine. After every time you run the engine, inspect it carefully for fuel and oil leaks.

All of the engine systems should be checked: propeller, governor, oil system, fuel system, exhaust system, engine controls, etc. before proceeding to the initial taxi tests. During these engine run-ups, turn on each circuit breaker and test the operation of the circuit. Test all of the avionics and all instrumentation you have installed.

Special Considerations for Overhauled Engines

Freshly overhauled engines require a break-in procedure that is completely inappropriate for a new untested airplane—a typical mechanic will do a couple of short ground runs, take off and climb at full power and then spend a couple of hours at 75%. It is best if the engine has already been run-in by the overhaul shop.

The run-in serves two purposes: (1) to seat piston rings and burnish any new parts that may have been installed, and (2) to give the operator control over the first critical hours of operation, during which time he can observe the function of the engine by means of the test cell instruments. The Avco Lycoming Direct Drive Overhaul Manual, pages 9-1 through 9-4, specifies the recommended run-in procedure.

Lycoming prefers that the engine run-in be done in an engine test cell, however "in the event a test cell is not available, it is permissible to mount the engine in the airframe for the run-in providing the following requirements are observed: 1. The proper test club, not a flight propeller, is used. 2. A cooling shroud equivalent to a test cell cooling shroud is used. 3. The airframe gages may not be used. All necessary calibrated gages shall be installed independent of the airframe."

The test club is a "proper" one if it allows the engine to turn red-line rpm at full throttle, plus or minus 50 rpm. A constant speed propeller will do this, but it will fail to supply the adequate amount of cooling air to the engine. A test club is short and is designed to provide a good flow of cooling air in close to the cylinders. The FAA will allow a ground run-in with a constant speed propeller providing that a CHT probe is installed on each cylinder and that the cylinder head temperature limits be observed. This is a very poor idea, and you are almost certain to glaze the cylinder walls. If you do that, the engine will never stop pumping oil.

If you must do the run-in on the airplane, you will have to combine it with the initial engine starting procedure. In addition to the baffling, bend up some galvanized sheet to direct air from the prop down over the cylinders. If your existing gauges are calibrated to known accuracy, you may disregard the prohibition of using the airframe gauges.

The Lycoming run-in regimen calls for successive 10-minute runs at 1,200, 1,500, 1,800, 2,000, 2,200 and 2,400 rpm, followed by 15 minutes at rated rpm—2,700 rpm. A mag check is performed at 1,800 rpm. Discontinue the run any time an oil leak or other unsatisfactory condition is spotted. (Continue the run from where you left off, after first allowing the oil to get to 140°F while idling at 1,000 rpm.)

The run-in should take place in a heated hangar, if necessary, so that the engine and oil are at a reasonable temperature (i.e., room temperature) before beginning. Also, observe the pre-oiling precautions stated in Lycoming Service Instruction No. 1241 (remove the top spark plugs and turn the engine with the starter, mixture in idle cutoff, until *at least 20 psi of oil pressure* registers on the gauge, then reinstall the plugs and start up.)

After the run-in, Lycoming recommends an oil-consumption run consisting of full rated power for one hour. (This is where the test club and cooling shroud are mandatory.) Weigh the oil before and after the run to get an accurate measurement. The maximum oil consumption for the 0-320 and IO-320 engines is 1.2 pounds (.67 quarts) per hour. For the 180 hp IO-360 B1E, it is 1.4 pounds (.78 quarts) per hour.

All of this presumes that you have standard steel (or nitrided steel) cylinder barrels. Chrome barrels present a problem in that ring seating is apt to be poor (and oil consumption high, for the life of the engine) unless high-BMEP (high brake mean effective pressure) operation can be conducted—with plenty of cooling airflow—immediately after initial warmup. This normally means flying the plane. To do this on the ground, put a test club and cooling shroud on the engine, face the plane into the wind, and run at rated power until ring seating occurs (signified by a drop in CHT). A four cylinder CHT is highly recommended—if only for test purposes.

Ring seating will be 90% complete after the factory-recommended run-in regimen. Use straight mineral oil for the next 50 hours or until oil consumption stabilizes (at which time you can and should switch over the ashless dispersant oil).

Observe due caution when running on the ground. Operate in as clean an environment as possible, be sure the cooling shroud is securely anchored (and doesn't touch the club), keep interested onlookers well away, and be prepared to kill the engine at any time, should trouble develop.

Initial Taxi Tests

After everything is working well, it is time for the initial taxi tests. Prior to taxiing the aircraft under its own power, have a helper give you a slow push to test the brakes. Once you are sure you can stop the aircraft while being pushed around, you are ready to proceed with the power taxi test.

In a large open area, test steering with the nose wheel. Test the brakes with light braking applications to make sure they work. Be sure to test left, right and both brakes, then test left, right and both brakes with the parking brake valve on. Since the brake lining has not yet been conditioned, all initial braking tests should be from low speeds and with light pedal forces.

During the initial taxi tests, you should become comfortable with the ground handling and steering of the Falco. The Falco is an easily controlled aircraft on the ground and is quite maneuverable with its nose wheel steering alone. The Falco does not have bungees in the nose gear steering, so the steering is direct and precise. The brakes do not have sufficient power to keep the airplane from moving at full power.

During these taxi tests, check the turn and bank, airspeed indicator and fuel flow from each tank. If you have an autopilot installed, turn it on and check that it is hooked up correctly, i.e. a right turn will make the autopilot move the stick to the left.

Brake Conditioning

The lining used in the brakes is an asbestos-based organic composition. The material must be properly conditioned in order to provide optimum service life. The purpose of the conditioning is to cure the resins in the lining. Excessive heat applied before curing will carburize the lining material, thus preventing the attainment of required braking coefficient.

To condition the brake linings, perform a minimum of six light-pedal-effort braking applications from 20 to 35 kts. Allow the brake discs to partially cool between stops. This conditioning will generate sufficient heat to cure the resins in the lining, yet will not cause the material to become carburized due to excessive heat. Once the linings are cured, the braking system will provide many hours of maintenance-free service. Be sure to do this on a good condition taxiway or on the runway. Do not attempt this in the parking area.

The speeds recommended for brake conditioning get up into the realm of high speed taxi tests, so you should conduct the brake conditioning with the same caution as a high speed taxi test. Accelerate with moderate power to about 20 kts and stop the airplane with light pedal pressure. After six braking applications from 20 kts, proceed with the high speed taxi tests and continue to use light braking when safety permits.

Controls Authority Taxi Tests

Since it is possible—but not desirable—to get airborne during taxi tests, you should treat the taxi test as though it will be a full-fledged flight. All FAA inspections, airworthiness certificates, registration, weight and balance, licenses, pilot qualifications, placards, restrictions, logs, etc. should be completed prior to any testing. It's too easy to become airborne on taxi testing, so do all the paperwork first.

You should do a complete pre-flight inspection before beginning taxi tests. Use the F.8L Falco Flight Manual for pre-flight, starting, warm-up and run-up checks. If you use a check list, you'll never forget an item. If you attempt to memorize a check list, things can be forgotten. You may wish to add additional items, such as checking the side load struts on the gear, screwjacks, brake lines, microswitches, landing gear doors and linkage, vents, exterior surfaces, particularly the bottom of the aircraft.

Since flight is a possibility, you should consider the advisability of a parachute and/or the value of a more experienced test pilot. The FAA usually requires that initial test flights be made by a single pilot, but these initial taxi tests may be made with two on board. An experienced pilot can tell a lot about the handling of an airplane during high speed taxi tests, so get all the help you can get.

These tests should be done in a building block fashion to just *under* rotation speed (although—see below—we really intend the aileron and elevator control tests to be terminated at low speeds). On some aircraft, high speed taxi tests are done up to rotation speed. The Falco, however, sits in a nose-high position on the ground—essentially the same as the takeoff attitude. While the engine thrust will pull the nose down on initial roll, chopping the power could lead to an inadvertant lunge into the air. Falco pilots say that "it wants to fly" or that it "slips into the air," but they are just describing an airplane that doesn't require a positive and dramatic rotation on takeoff.

Fill each tank approximately half-full with fuel, and check the weight and balance to make sure that the CG location is within CG limits—preferably in the forward half of the CG range. A 4,000' minimum hard surface runway should be used. The Falco accelerates quickly but doesn't decelerate too well. Be careful not to overheat the brakes if a lot of braking is used to slow or stop the aircraft.

We recommend the six taxi tests listed below. While these tests may sound strange to the uninitiated, these are normal tests for new aircraft designs. Even with a proven design like the Falco, you should make *no assumptions* that the rudder, nose wheel steering, ailerons or elevators will work—you should *test them*, on the ground and at nice safe speeds. Can you imagine how foolish it would be to fly the airplane and *then* discover that the controls on your airplane do not actually work as designed! It is not enough to see the controls move in the right direction.

The classic example of this is the McDonnell Douglas F.18 Hornet. Before the aircraft was flown, it was given an elevator effectiveness test. In a series of tests at gradually increasing speeds, the aircraft was accelerated, and the stick was brought full aft. At calculated lift-off speed, the elevator did not have enough power—it took an additional *20 knots* to lift the nose. By doing this very safe test on the runway, the engineers were able to locate the strange aerodynamic cause—something about notches in the tail. They had to reprogram the aircraft's fly-by-wire computer so that on takeoff the dual rudders deflect inboard, pinching the air. The drag on the tail helps pull the nose up.

A friend of ours built a two-place kitplane, a well-proven and popular design. No controls effectiveness tests were done on the ground; the pilot simply took off. The airplane was badly out of rig and required full right aileron to fly straight and level. Fortunately, the pilot was very experienced and was capable of handling the plane. If the plane had been a little more out of rig, the pilot would have been incapable of stopping the roll, and he would have died. It seems so stupid to rely on skill and luck when you can quite easily discover a problem like this while safely on the ground.

Directional Control Taxi Tests. The first three taxi tests check the directional controls during initial takeoff roll: Can you maintain control of the airplane with rudder and nose wheel steering?

If computed liftoff is 55-65 KIAS, then do three runs at 20, 40 and 50 KIAS. Conduct each one at full power until the test speed is reached. Use takeoff flaps (15°) for all of the high speed taxi tests—since full-down aileron is 16°, a simple way is to align the flaps slightly above full-down aileron. Hold the stick neutral and simply get a feel for the directional control at progressively increasing ground speeds.

If everything is normal, you should find that the nose wheel steering of the Falco is sensitive and direct. On rollout, you should find that steering is more a matter of changing the pressure on the rudder pedals rather that actually moving anything. Most pilots are surprised by the strong takeoff torque—remember, the Falco's power-to-weight ratio is lower than most production singles. With a neutral stick, you may notice the tendency of one wing to rise, giving you an early indication of a "heavy" wing.

Aileron Control Taxi Tests. The 4th and 5th runs test the effectiveness of the ailerons. After these aileron control authority tests you will have learned a great deal about what to expect of the lateral controlability prior to the first flight.

Begin the test from a dead stop on the runway holding full left aileron and neutral elevator. With takeoff flaps, accelerate with full power and maintain directional control with nose wheel steering. As you accelerate toward liftoff speed, note the speed at which the *proper* wing begins to rise. Once the wing begins to rise, neutralize the stick, select idle power and roll to a stop. Repeat this for the right aileron.

▲ Warning This is intended to be a *low speed* test. On a normal Falco it should not be necessary to go more than 20 to 30 knots to confirm the authority of the ailerons. If the low speed tests do not show the expected control authority, we think the tests should be halted. An experienced test pilot may decide to continue this test at a higher speed, but do not exceed 50 kts during this test—you do not want to get airborne with lateral controls applied. ▲

What was the response to full aileron upon reaching the minimum lateral control speed. Was it excessively touchy? Did the wing tend to snap up or just gently rise? If everything is normal, you can expect the Falco's ailerons will begin to have an effect at moderately fast taxiing speeds of 20 kts or so. The wing will begin to rise smoothly at surprisingly low speeds. Remember, the Falco has much more aileron power than a typical monoplane—exceeded only by specialized competition aerobatic airplanes. The stick should have taken very little force to hold it in the full-aileron position. The stick pressures in flight are about the same.

On a new design, if the wing did not rise prior to computed liftoff speed, you would have a *big* problem with the airplane. The ailerons are so weak, the airplane should probably be redesigned before flight is attempted.

Elevator Control Taxi Test. The last taxi test checks the elevator control authority. With neutral ailerons and takeoff flaps, start from a dead stop with full aft stick and accelerate at full power. Note the speed at which the nose wheel begins to lift off, and immediately select idle power and *ease* the stick back to neutral.

▲ Warning This test is intended to be a *low speed* test. On a normal Falco it should not be necessary to go more than 20 to 30 knots to confirm the authority of the elevators. As you approach calculated liftoff speeds, there is the possibility of an abrupt liftoff. You do not want to have to cope with this, especially in an airplane where you already know you have a problem with the controls. ▲

If everything is normal, you can expect the Falco's elevator to be effective from the first application of power. Even without the airplane moving, the elevator should bring the nose up slightly. As the airplane begins to accelerate, it is possible to drag the tail of the airplane on the ground if you continue to hold in full back stick. Note the stick forces for full elevator—the pressures in flight are about the same. You should also note that the stick forces for the elevator are about the same as for the ailerons.

If the low speed tests do not show the expected control authority, we think the tests should be halted. An experienced test pilot may decide to continue this test at a higher speed, but this should only be done by an experienced test pilot.

Now, take the airplane back to the line and park it. Fix anything that needs fixing. Think over what you just experienced and if everything seems okay, review your test plan for the first flight.

A Safe Landing (The First Flight)

The purpose of the first flight should be to find out how the airplane flies in the dirty configuration and during approaches to landing so that you can safely land at the end of the first flight and call it a success. All activities on the first flight should be toward the goal of a safe landing. Forget about raising the landing gear, operating the radios, or the performance of the airplane. A safe landing is the total mission.

You can expect to find that the Falco will have one "heavy" wing and will require a tab on one or both ailerons. (Forget about trying to trim this out with differential adjustments of the flaps. This has been tried, and it simply does not work.) It's a good idea to make up such a trim tab in advance and have it ready for installation. Use a piece of .032" 2024-T3, cut it about 3" by 12", and install it with five or six No. 6x1/2" TRA screws. If the right wing is "heavy" then you should install the trim tab on the bottom of the left aileron and bend the trailing edge of the tab down.

Remove all landing gear doors. This is particularly important if the break-in requirements of a recently-overhauled engine requires you to fly the airplane at a high power setting—as in the case with a chrome overhaul. Without gear doors, you should have no great restrictions if you keep speeds below 130 knots, and if you have to retract the gear you could do so.

Plan an initial flight of about 45 minutes with each tank half-filled. Set the trim at exactly neutral (with the tab directly aligned with the elevator) or slightly nose-down (with the trailing edge of the tab about 3mm above the trailing edge of the elevator). Conduct a thorough pre-flight inspection and a weather check. The Falco is a good crosswind aircraft, but you should consider a 10-knot crosswind the maximum for the first flight.

Use takeoff flaps (15°) and rotate at a higher speed than the anticipated stall speed. Remember, the intention is to insert the airplane into the middle of the flight envelope—you do *not* want to force the plane off the ground at the ragged edge of the stall. Let the speed build up to at least 65 KIAS before rotating, and even then do not force the airplane into the air prematurely if it does not appear ready to fly. Use very gentle motions of the elevator. Once the airplane is flying, climb straight ahead and get altitude before doing any turns, and the first turns should be very gentle ones.

Corwin "Corky" Meyer, for many years the chief test pilot at Grumman, says "Mel Gough, a very talented test pilot for NACA once told me his philosophy of first flight testing: After you take off, roll your eyes slightly. If nothing happens, start moving the controls very slowly! I couldn't agree more!"

Climb out at 80-90 knots indicated with the error on the high side until you get used to the airplane. Don't be in a hurry to raise the flaps after takeoff. Just settle down, fly the airplane, and climb to an altitude of at least 300-500 feet before raising the flaps. Be on guard and stop raising the flaps on the slightest hint of an unintentional roll. Do not reduce the throttle or propeller RPM until you have reached at least 3,000 feet above the airport. When you do reduce power, you will find a good climb setting is 25"/2500, and you should get 600-800 fpm rate of climb even with the gear down. Climb to 3,000-5,000 feet AGL and feel the aircraft out.

With the flaps up, do a series of gentle maneuvers to become used to the ailerons, elevator and rudder. Settle down and get used to flying the airplane. Practice turns, climbs and descents.

Check the engine instrumentation and note the temperatures and pressures. Note any discrepancies such as a heavy wing.

When comfortable with the airplane, slow down to flap speed, lower the flaps to landing position (20°) and check the control responsiveness in slow flight at 70-80 knots. Practice turns, climbs and descents. Note the power settings needed for 500 fpm and 1,000 fpm rate of descent.

The next step will be to do approaches to stalls. The purpose of these tests is to see what "message" the airplane is going to send you, and so that you will know what behavior to expect from the airplane on the first approach to landing. In the following sequence of approaches to stall, we include turns to the left and right. These turns should be the same *gentle* (15° to 30° of bank) turns you will make in the landing pattern—you do *not* want to horse the airplane into a steeply banked accelerated stall! If the airplane exhibits any undesirable behavior during an approach to stall in a gentle turn, then you will know to avoid any low speed turns at pattern altitude.

Since an aircraft will typically exhibit its mildest stall behavior with idle power—and its most vicious at full power—we recommend that approaches to stalls first be done with idle power and then with power on. "Power on" means any moderate cruise power setting—not full power. If a wing drops in a stall, pick it up with opposite rudder. An attempt to pick it up with aileron will aggravate the wing drop in some airplanes.

In the following approaches to stalls, do not take it too deep into the stall initially. With each test, note the airspeed at which the first sign of buffet occurs, and note if the buffet is easy or hard to detect. These observations are important to make prior to conducting actual stalls and will help you adjust the stall strips as required.

Approach to Stall	Power Setting	Flap Setting
Straight ahead	Idle power.	Flaps up.
Straight ahead	Power on.	Flaps up.
Left turn	Idle power.	Flaps up.
Right turn	Idle power.	Flaps up.
Left turn	Power on.	Flaps up.
Right turn	Power on.	Flaps up.
Straight ahead	Idle power.	Landing Flaps (20°)
Straight ahead	Power on.	Landing Flaps (20°)
Left turn	Idle power.	Landing Flaps (20°)
Right turn	Idle power.	Landing Flaps (20°)
Left turn	Power on.	Landing Flaps (20°)
Right turn	Power on.	Landing Flaps (20°)

When satisfied with slow flight characteristics, you may do some full stalls. For the mission of the first flight, this is not essential, but it will add to your knowledge of the airplane. The stall sequence given below is a minimum "first taste" only.

Stall	Power Setting	Flap Setting	Notes
Straight ahead	Idle power.	Flaps up.	Should occur at about 65 knots.
Straight ahead	Power on.	Flaps up.	
Straight ahead	Idle power.	Landing Flaps (20°)	Should occur at about 65 knots.
Straight ahead	Power on.	Landing Flaps (20°)	

Raise the flaps, settle down in level flight and make any additional notes about stalls, stall warning speeds, stall buffet, aileron control effectiveness in the stall, etc.

When confident in the recovery and stability from stalls and with the knowledge of stall speeds, fly a landing pattern at altitude (at least 3,000' AGL) and proceed through the landing flare to an imaginary runway. Fly the approach at about 80 knots and with 20° of flaps, and then use 70 knots over the fence (or at least 1.3 times stall speed). This is a good chance to check balked landings and go-around performance, so after you have flared for the imaginary landing, give it full throttle and climb out as though it were a normal airport.

If necessary, do several of these practice landings on an imaginary runway at altitude until you are comfortable with the airplane. Note the handling of the Falco during these practice landings—it's fingertips all the way down. As you can see, you do not have to get an iron grip on the stick when you do your first real landing.

Raise the flaps, settle down in level flight and make any additional notes on the operation and handling of the airplane. Check the engine instrumentation and take a second reading of the temperatures and pressures.

By the time you're done with all this, you should feel comfortable enough to come in and do a full stop landing—no touch-and-goes on the first flight. Remember to fly the approach as though the engine will quit at any time. If you are not satisfied with the approach, go around. You cannot make a decent landing out of a bad approach, so if the approach is not going well, add full throttle and go around—preferably at 200 feet or above—and keep shooting approaches until you have it right. Don't let the prohibition on touch-and-goes force you into making a bad landing.

If everything is going well, strongly resist the temptation to try something else. Plan the flight and fly the plan! Remember, flight test centers have long ago found out that the explanation for most accidents begins with "Well, everything was going so well that I...."

After landing, review your notes, fix things that need fixing and/or adjustment and then get ready for the next flight.

Gear Retraction (The Second Flight)

The purpose of the second flight is to establish that you can raise and lower the landing gear and to check the handling of the airplane with the gear up. The overall plan is to take off, climb to altitude, cycle the gear and then repeat most of the same handling tests of the first flight but in the clean configuration.

Before starting the engine, confirm that the jumper (for ground retraction tests) is not installed. With the landing gear motor *disengaged*—pull the knob on the gearbox knob up—push the landing gear circuit breakers in, turn the master switch on and select "gear up". The gear warning horn should sound, the gear warning light should light up, and the landing gear motor should not turn. This simple test confirms that the landing gear cannot be retracted with the pitot-pressure switch at an airspeed of zero. It does not guarantee against all mishaps, so leave the landing gear motor in the disengaged position.

Using the same procedure as for the first flight, take off and climb to 3,000 to 5,000 feet above the airport. When settled down in level flight, slow the airplane to gear speed (108 knots—it's indicated on the airspeed indicator) engage the motor and select "gear up." Be prepared to pull the landing gear actuation circuit breaker if the motor stops turning and the landing gear "in transit" light stays on. After the gear is fully retracted, use the hand crank to determine if the motor retracted the gear all the way.

To extend the landing gear, slow the airplane to gear speed and select "gear down." Be prepared to pull the landing gear actuation circuit breaker if the motor stops turning and the landing gear motor "in transit" light stays on.

The green "gear down" light indicates that the down limit switch has been tripped. It does not assure you that the screwjacks are compressing the springs. It's possible that air loads or something else might prevent the system from coasting into the springs. Thus you must check the "coast" of the system. After the gear is down, use the hand crank to extend the screwjacks all the way until they reach the end of their stroke. Count the turns required. As the springs require 3.9 turns for their full stroke, you should have something less that. It is essential that you know that the screwjacks are pushing on all of the springs of the screwjacks. The only way you can be assured of this is to count the turns from when the system shuts down to fully extended.

The normal procedure to lower the landing gear is to let the electric motor do all of the work, check that you have a green "gear down" light, and land the airplane. There is no need for extra turns on the hand crank once you are completely sure that the system is working as designed, but check the system every time until you have confidence in it.

With the gear and flaps up, repeat the handling test of the first flight: practice turns, climbs and descents. Check the control responsiveness in slow flight at 70-80 knots. Do the following approach to stall and stalls.

Approach to Stall	Power Setting	Flap Setting	Notes
Straight ahead	Idle power.	Flaps up.	
Straight ahead	Power on.	Flaps up.	
Left turn	Idle power.	Flaps up.	Gentle turn only.
Right turn	Idle power.	Flaps up.	Gentle turn only.
Left turn	Power on.	Flaps up.	Gentle turn only.
Right turn	Power on.	Flaps up.	Gentle turn only.

Stall	Power Setting	Flap Setting	Notes
Straight ahead	Idle power.	Flaps up.	Should occur at about 65 knots.
Straight ahead	Power on.	Flaps up.	

If your airplane is flying like a Falco, then you can begin to relax a little. There is no special urgency to do additional tests, so spend time flying the airplane and getting used to the controls. Practice flying the airplane in a normal way. Do climbs, descents and turns. Leave accelerated stalls, spins and aerobatics for much later. It makes no sense to get into that stuff until you are very much at home flying a Falco.

Return to the airport and land. Review your notes, fix all discrepancies and prepare for the next flight.

Systems Checks (Subsequent Flights)

By the third flight you should be familiar with the handling of the airplane that you can conduct systems tests to make sure everything works as advertised. The last thing you should think about testing is performance. Make sure everything is working as it should after the first few tests, make sure the handling qualities are the way a Falco's are supposed to be.

Put a high priority on getting used to flying the Falco. It is much more important that you build up time and learn to fly the Falco the way a Falco needs to be flown than it is to check the operation of the radios, navigation equipment or lighting system.

These flights should be as carefully planned and executed at the first two flights. The exact order is not critical, but should include the following:

- Fuel system. Check the flow of fuel from the aft tank.
- Gear doors installation and check.
- Pitot-pressure switch check.
- Trim tab control system
- Electrical system
- Audio and avionics
- Landing light
- Strobe lights
- Navigation lights
- Instrument panel lights
- Alternate static source and its effect on instrument readings.
- Autopilot operation.
- *What else?*

Gear Door Installation and Check. After the second flight, you can put the gear doors back on. Depending on options, the Falco may have a total of seven gear doors: two main gear doors, a nose gear door, two main gear wheel well doors, and two nose gear bay doors. These doors should be installed and tested in separate steps. Do not attempt to install all of the doors at once.

When you are confident of the landing gear retraction system, install the gear doors on the main gear. Jack the airplane and cycle the gear to make sure the doors fit right and operate properly. Then do a test flight to check the system in the same manner as for the first gear retraction.

Then install the nose gear door on the nose gear trunnion and repeat the retraction tests. Repeat the retraction tests for the installation of the nose gear bay doors and the wheel well doors.

Pitot-Pressure Switch Check. To test the operation of the pitot-pressure switch, lower the landing gear and flaps to 15°. Slow the airplane to just above stall speed and select "gear up." The horn and light should come on, and the landing gear should not retract. With the landing gear switch still in the "gear up" position, increase the speed of the airplane slowly until the light and horn goes off and the gear retracts. This should occur at 68 knots indicated. Because of tolerances in the pressure switches, there may be some variation from this speed.

The landing gear system features circuitry to warn you to lower the landing gear when you have the airplane in landing configuration. This system uses the flap position switch, the throttle position switch and the pitot pressure switch. Test the operation of each part of the system.

The flap position switch should close at 17° of flaps. Takeoff flaps are 15°, and you do not want the horn and light coming on right after takeoff—which would happen if the flap position switch were closed for the takeoff flap position. The initial landing flap position is 20°, so you want the flap position switch to always close when you have flaps at 20°. (Because of this, you should religously use 20° of flaps for landing. Selecting less flaps might keep the system from warning you of a gear-up landing.)

First, test the throttle position switch to determine its throttle setting. With the gear up, slowly reduce the throttle until the horn and light come on. Note the manifold pressure setting.

Increase the throttle setting very slightly so that the switch opens and the horn and light go off. By raising the nose of the airplane, slow the Falco to flap speed and lower the flaps to 15°, then increase the flap setting by one-degree increments until the horn and light come one. Confirm that the flap position switch is closed at 20° of flaps.

Depending on the settings of your aircraft, the throttle position switch may require some adjustment. The intent of the landing gear warning system is that flap and throttle switches will give you a warning before any possible gear-up landing. Thus, the airplane should maintain altitude with the flaps down to *almost* enough to close the flap position switch and with the throttle reduced to *almost* enough to close the throttle position switch. If this power setting is enough to maintain the Falco in level flight at all reasonable propeller RPM settings, then the system is set up properly. If the airplane will descend, increase the throttle until it will maintain level flight. Mark the position of the throttle control arm. After landing, adjust—sand—the throttle position switch cam so that the switch will close at the desired throttle position.

Test the "horn off" switch by retarding the throttle until the horn and light come on, then turn the "horn off" switch to the "horn off" position. Check that the landing gear warning light continues to light up while that the horn stops sounding and the "horn off" light comes on.

Chapter 3
Advanced Flight Testing

This chapter covers the methods used for advanced flight testings. Not all of the methods must be used on your Falco.

Aerobatic Maneuvers

The Falco is an aerobatic airplane, and rare is the Falco pilot that does not want to do some acro. If you have never received any acrobatic instruction, get some! Instruction is the *only* way to learn aerobatics.

There are many good books on the subject. *Flight Unlimited* by Eric Müller and Annette Carson is probably the best. Others are *Aerobatics* by Neil Williams, and Duane Cole has a number of books out.

Before you get into this, you should become very comfortable with the airplane. An experienced pilot may settle into the Falco in twenty hours or less, while the low time pilot should probably get several hundred hours in the Falco before getting into advanced maneuvers.

Do not attempt any accelerated stalls, spins or acrobatic maneuvers without an aerobatic instructor. And when you do aerobatics, there are a few things to watch out for.

- The Falco is an aerodynamically clean airplane, so you can pick up speed quickly in a dive.
- The Falco rolls as easily as any airplane that's ever flown. It's quite easy to become proficient with quick aileron rolls, and before you know it you will be doing them with ease. *This does not mean that you are now a good acrobatic pilot!* The Falco will make you look better than you are, and you might be tempted to do some low level acrobatics. Don't. Make a hard-and-fast rule of 1,500 feet above ground before you do any acrobatics. If you want proof that the Falco is making you look good, get a ride in a Decathalon and try a slow roll. Humble pie is a tastier supper than dinner with St. Peter.
- Little is known about the inverted-flight characteristics of the Falco. Only one pilot has flown the Falco in negative-g maneuvers, and he has only done it for 15-second intervals of simple straight and level flying.

Flutter Testing

Flutter testing falls under the category of development flight testing. Flutter is a condition in which the controls of an airplane vibrate up and down. All aircraft will exhibit flutter at some speed, so there is no such thing as a light aircraft being totally free of flutter—only free of flutter within a certain speed range. Thus, it is not a question of whether the Falco will flutter—*it will*—but whether flutter will be encountered within the flight envelope.

The Falco has a design speed of 231 knots. The design speed is the greatest speed at which the aircraft is designed to fly. Flutter testing is done up to the design speed, then the never-exceed speed is set at 90% of the design speed. Thus, the never-exceed speed of the Falco is 208 knots (231 knots x .90). Flutter testing is normally done on a prototype and when aircraft come off the assembly line there is no flutter testing done on them. As part of the certification procedure, the production Falcos were tested and demonstrated to be free of flutter, and there has not been a single incidence of flutter in any of the Falcos, production or homebuilt.

There is one problem you should know about. The balance of the control surfaces is very important and is included in the flight manuals or maintenance manual for an aircraft; however, in the case of the Falco, no control surface balance specifications were ever published. The balance specifications we use were supplied by Falco designer Stelio Frati, and David B. Thurston, aeronautical engineer. Mr. Frati's specifications exactly agreed with the recommendations of Dave Thurston. Dave Thurston's recommendations were for "80% balance" which he had also specified for the Bellanca Skyrocket II—a 300 mph aircraft.

We believe that the control surfaces that our builders are using are identical in balance to those of the Series I and II Falcos, however we are unable to offer definitive proof. We also believe that the likelihood of flutter on a Falco (with correctly balanced controls and correctly tensioned cables) is extremely remote. This belief can only be proved by a flight test. On homebuilt Falcos, we have had one Falco builder do a complete flutter test regimen (as described below) up to 190 knots indicated. This same pilot has flown his Falco to 220 knots indicated, not a true flutter test, but it certainly should give everyone comfort.

Should you flutter test your Falco? The advice that we have gotten from two experienced test pilots is "No." One, who knows Dave Thurston well, simply says that he would rather build it the way Dave Thurston says and forget about it since he would regard that as enough, particularly considering the testing of the probably-identical prototype Falcos. He also questions whether anyone but a very experienced test pilot should be doing this type of testing at all. The other simply says that he does not think that there is much to be gained from such a test.

In view of the above, we think it is quite reasonable for Falco pilots to do no flutter testing. If you wish to do flutter testing, the basic method is given below. Flutter is something that should be approached with *extreme caution*. To follow the normal engineering test practices of prototype aircraft, you should test the Falco to be free of flutter at 231 knots if you are to use a never-exceed speed of 208 knots. Not a pleasant thought. If you decide to test the airplane to design speed, you should consider the advisability of having a skilled test pilot—complete with parachute—do the testing. The pilot should be able to fly to the exacting airspeed increments demanded by the flutter tests.

To test for flutter, you fly the airplane at a speed and then pulse the stick. (Simply flying the airplane to design speed or Vne is *not* a test for flutter.) Start at a speed of 140 knots indicated, gently slap the control stick on each side to test the ailerons, and then repeat the process on the front and back to test the elevators.

As you increase the speed of the aircraft, the first type of flutter you will encounter (if you encounter it at all) is damped flutter. With damped flutter, the slight blow to the controls will excite the controls into a "buzz," or shaking action, which will quickly die down. If you increase the speed very slightly, the flutter will become less damped, so it will die down less quickly. Increase the speed more, and the flutter will become divergent.

Divergent flutter will cause the controls to increase the magnitude of the movement of the control surface. Divergent flutter is extremely dangerous since it normally leads to the destruction of the airplane. Needless to say, divergent flutter is to be avoided at all costs.

So what you want to do is to test for flutter at small increments of speed increases until you find the first hint of damped flutter or until you reach Vne (or design speed). At the lower speeds, increments of 5 knots may be used, but this should be reduced to 2-3 knots as Vne (or the design speed) is approached.

Since flutter is a function of speed, and normally requires some excitement of the controls to begin, the safest technique is to dive the aircraft to slightly above the test speed and then pull up to a shallow climb. The shallow climb will cause the aircraft to slow down, and you wait until the desired speed is reached before pulsing the stick. If flutter is encountered, the deceleration of the shallow climb will insure that the airplane will quickly reach the slower speeds at which you have already proved that the Falco is free of flutter. Thus, each step out to the unknown is conducted as a step back into the known.

At each speed, repeat the test a minimum of three times for the ailerons, three times for the elevator and three times for the rudder before increasing the speed. At the first sign of flutter, terminate all the flutter tests. You then have the option of taking steps to increase the flutter-free speed of the airplane (normally by adding weight to the leading edge of the control surface) or of setting the never-exceed speed to 90% of the highest tested flutter-free speed.

Spin Testing

It is not essential that you conduct spin tests, but if you intend to spin the aircraft, the first spins should be conducted as a flight test. Approach spins cautiously: stop the first spins as quickly as possible and then build up gradually from a half-turn spin to a one-turn spin, then to a one-and-a-half-turn spin, etc.

First off, do not attempt any of these spins if you are not extremely experienced with spins. Either get a test pilot or an acrobatic instructor to do all of these for you or with you. A low time pilot has absolutely no business doing spin tests in any aircraft.

Second, center of gravity is very important, and all spins should be done at forward CG. The Falco recovers from a spin very quickly, but we do not know if it has ever been spun at an aft CG.

Third, it is best to promulgate only one spin recovery technique. We believe the best all-around technique is: Cut the throttle, take your hand off the stick, kick full opposite rudder until the spin stops, then neutralize the rudder and pull out of the dive. This is the "Beggs method" and is discussed below.

A spin is a complex aerodynamic event, and you should understand the dynamics of the spin. Before attempting any spin tests, our strong recommendation is to read the chapter on spins in *Flight Unlimited,* by Eric Müller and Annette Carson, published by the authors at 28 Chiltern Avenue, High Wycombe, Bucks, HP12 3UR, England and available at most aerobatic training schools. This book has a superb discussion of the dynamics of a spin, which is summarized below. If you find this discussion difficult, more's the reason to purchase the heavily illustrated book—the best ever on aerobatic flying.

A stall has nothing to do with speed, only with the angle of attack. After a wing has stalled, it still produces a certain amount of lift. With increasing angles of attack, the drag coefficient continues to increase as the lift coefficient reachs its maximum (at the critical angle of attack) and starts to drop.

If the airplane drops one wing, the dropping action produces a relative airflow from below, and this produces an even higher angle of attack for that wing. When one wing goes down, the other must rise, so exactly the opposite happens to the rising wing: the relative airflow now has a downward component and produces a reduction in angle of attack.

When this wing-dropping occurs in a stall, both wings are stalled. The increase in angle of attack for the dropping wing decreases the lift and increases the drag of that wing. The decrease in angle of attack for the rising wing increases the lift and decreases the drag of that wing. Thus, because the dropping wing has more drag, it is pushed backwards with greater force than the rising wing. This is why, when an airplane with an angle of attack above the critical angle starts to rotate, it rotates not only around the longitudinal axis (due to the difference in lift) but also around the vertical axis (due to the differences in drag). These two rotational movements combine to give us a new axis—the spin axis—and explains the characteristic attitude and movement of the aircraft in the spin.

When a force is exerted, it produces an acceleration until it meets an equal and opposite force which will keep the rate of movement constant. Thus, the spin will accelerate until aerodynamic forces producing the spin are the same as the forces against the spin.

A common error in thinking is that you should first reduce the angle of attack. This causes the lift coefficients of both wings to increase, but there is still a difference between the forces that creates the spin. You must first deal with the pro-spin forces, not the angle of attack. Since moving the stick forward will increase the rate of rotation (that's how air-show pilots do fast-turning spins!), don't do that while you are trying to stop the rotation.

An aileron is designed to increase the lift of a wing when it is lowered, and this increases the drag for that wing. However, when the wing is stalled—as are both wings in a spin—it is likely, or at the very least possible, that lowering an aileron will actually decrease the lift. (Remember, above the critical angle of attack an increase in the angle of attack results in a decrease in lift.) When that happens the ailerons produce the opposite effect—aileron reversal.

In a spin, down-aileron on the dropping wing will increase the drag and quite likely decrease the lift at the same time, thus having a pro-spin effect. At the same time, up-aileron on the rising wing increases the difference in drag between the wings: another pro-spin effect. So moving the stick toward the rising wing (out-spin) will not counteract the rotation.

If on the other hand, the stick is moved toward the dropping wing, it will decrease the drag on the high-drag dropping wing and increase the drag on the low-drag rising wing—thereby reducing the differences between them. At the same time, the lift difference between them can also be reduced by the aileron reversal effect. Thus it appears that in-spin ailerons is best to counter the autorotational forces of a spin.

(Müller warns that this is not always the case. Very long wings or those with lots of wash-out can quite possibly have one or both ailerons working normally in a spin, because the inboard section of the wing has an angle of attack over the critical, producing autorotational forces, while the angle of attack at the outboard section can still be sub-critical. With such aircraft you can actually stop the autorotation quite simply be giving opposite aileron. This is not the case with the Falco—in-spin aileron helps stop the spin.)

The elevators control the angle of attack, but reducing the angle of attack will not eliminate the differences between the wings. With a tail design like the Falco's, down-elevator shields the rudder from the airflow to a significant extent (known as blanketing effect), but if the elevator is deflected upward, much more of the rudder is exposed to the relative airflow. (See Müller's book for a discussion of the T-tail configuration, and 'unconventional' aircraft which have the elevators located behind the rudder.)

With a right-turning engine of the Falco, the engine's gyroscopic forces cause the airplane to spin flatter when spinning to the left and to spin faster when spinning to the right. Since neither of these forces is helpful to spin recovery, the engine should be reduced to idle power.

The Müller method for spin recovery is: full opposite rudder, stick back and in-spin, and engine cut to idle. There is no order of priority. Put all of these control inputs together at the same time, and you have the fastest recovery from a spin. When the rotation stops, neutralize the rudder and do a normal stall recovery by moving the stick forward and increasing engine power. (Note that the spin recovery controls are also those for spin *entry* in the opposite direction.) Müller's method of spin recovery has been widely accepted by competition acrobatic pilots as the fastest method of stopping a spin. All tests in a Falco have shown it to be effective.

A big enemy of successful spin recovery can often be the pilot's state of mind. Frightened or disoriented, the pilot may try different ways of recovering because the first attempt didn't seem to stop soon enough. It is easy to misjudge a situation when you are frightened and a pilot who does will probably stop his spin in what Müller calls "ground effect". (In an inverted spin, the correct opposite rudder is "with" the visual rotation—if the world is whirling clockwise the opposite rudder is the right rudder in an inverted spin.) The ball of the turn and bank indicator normally gives a good indication of the rudder required for the recovery. The ball will be displaced into the yaw angle whether upright or inverted. "Step on the ball" is good to remember for proper recovery rudder.

In case of confusion Müller offers an easy-to-remember spin recovery method: release the stick, engine cut to idle, and push full rudder with whichever foot is getting most resistance from the rudder pedal. This will be opposite rudder, even if you are in an inverted spin. When you let go of the stick, it will go of its own accord to the correct position: back and in-spin for a normal erect spin. Müller stresses that this applies only to conventional aircraft types.

This method has been promoted by aerobatic instructor Gene Beggs to the point that everyone calls it the "Beggs method." (Beggs gives full credit to Müller, but everyone credits Beggs with popularizing this excellent technique.) With the exception of a few aircraft, the Beggs method has been proven to be the safest and best method for recovering from unintention spins of all types: erect, inverted, and flat. All tests in a Falco have shown it to be effective.

With most aircraft, spin behavior is not affected by trim, however the center of gravity can be important since CG can even replace the elevator effect, so aft CG will help increase the airplane's angle of attack.

Spin tests should be done with a lot of altitude—7,000 feet above ground is recommended. The rate of descent depends on many factors (spin development, aircraft weight, fuel loading, air density, etc.), and it can vary from about 100 to 300 feet per turn. "Since it is obviously not a reliable factor, you should *never* plan to finish a spin near ground level." Müller warns, "If you don't believe the truth of this, it won't be long before you join those other pilots in the next world who didn't believe it either!"

To enter a spin, reduce the power to idle, and increase the angle of attack with the diminishing airspeed so that you are flying in a straight line and a slight climb of 400 fpm. Gradually move the stick back until you notice the stall warning buffet—this is the spin entry speed. During this buffeting, keep the nose straight and wings level, which will require constant adjustment with rudder and ailerons. With the stick fully back and at the critical angle of attack, apply full rudder on the side to which you want to spin. (With its right-turning engine, the Falco will prefer to spin to the left, so if you want to spin to the right you must apply full rudder a little earlier, before the aircraft can drop to the left of its own accord.) Count the turns and apply the recovery procedure a half-turn before the intended end of the spin. The rotation should slow down at once.

The right moment to release back stick and opposite rudder is when the angles of attack of both wings have returned to sub-critical, which will be when you feel the aircraft wanting to sideslip in a vertical dive. This means that your controls have begun to work normally again. As you still have aileron deflection, a certain amount of rotation remains. A fraction of a second after you have centralized the elevator and released the rudder to keep the aircraft vertical, smartly centralize the ailerons. Make a pull-out of the ensuing dive and resume horizontal flight.

On the spin entry, if you cannot reach the critical angle of attack by applying full back stick, it is often because you do not have enough elevator power (not a problem with the Falco). It is often difficult to initiate an inverted spin even though the elevator is fully deflected. The answer to both problems is to give a quick burst of power. The propwash reaching the elevators will produce increased negative lift force, which will automatically increase the angle of attack. This is the reason why, at low speed and high angle of attack, you should never move the throttle forward without moving the stick forward at the same time—unless you want to spin!

After developing confidence in spin recovery with the Müller method in multiple-turn spins, do a test confirming the validity of the hands-off Beggs method. Do a normal spin entry. After the airplane starts to spin, remove your hand from the stick. In most airplanes it will remain back and go to the inside position of its own accord. Even if you centralize the stick and then take your hands off, it will still go to the same position again—exactly where you want it for spin recovery. Apply full opposite rudder and at the moment of stopping the rotation the stick should centralize itself— all confirming the Beggs method.

The following spin tests should never be done without the assistance of a competent aerobatic instructor familiar with such spins. Climb to 7,000 feet above ground.

Do a normal spin entry and when the rotation has stabilized, slowly move the ailerons to out-spin. Normally the spin will accelerate rapidly, and the aircraft's attitude will become very flat from the centrifugal force of the rotation. If the spin is to the left, add power and the aircraft should spin even flatter. The angular velocity will be very great—up to 360° per second in some planes. This is too fast for the human system to recognize points on the ground and if you try to catch sight of a reference point you will probably get sick, so look at the altimeter and the control stick instead. If you try pushing the stick further forward, the airplane may well rotate even faster than before, possibly vibrating at the same time.

This is known as the flat spin, which is known for its flat attitude, the low rate of altitude loss per turn and the fast rate of rotation. The flat spin is just a very well developed normal spin—the principles do not change at all. The flat spin recovery is the same as for a normal spin, but because it is so fast, it takes longer to stop.

Müller suggests the following demonstration of incorrect spin recovery technique. Enter a spin normally and after a few turns, push the stick forward as you apply opposite rudder. The rotation should slow down a little, but the airplane will not stop spinning. Eric Müller: "With this demonstration it is easy to see how many pilots before us have 'pushed' their spins right into the ground; and I am only sorry that the deathly spectre of 'pushing' out of the spin is still with us and greedily claiming so many lives. If you simply release the stick, it is amazing how quickly it goes automatically to the back and in-spin (recovery) position. I wonder why this is ignored by so many of those people who are concerned with safety in aviation?"

(A minor technical point: a spin is caused by stall and yaw. Stop either one, and you stop the spin. Thus it is possible to stop a spin in a Falco by moving the stick forward quickly—less than 3 seconds from full aft to full forward—while still leaving full with-spin rudder. This breaks the stall and the Falco will recover from a normal, unaccelerated spin in about one-half turn. It is possible to place the aircraft in a highly accelerated spin mode if this forward movement is not positive and quick enough. In an inverted spin, this cannot result in a recovery. This "break the stall" method should be considered of academic interest only. It is an interesting test, but no one should use this as a normal spin recovery technique.)

The spin of the Falco is slightly occilatory; that is, the rotation rate varies as the angle of attack changes. All spin tests in the Falco have shown that the Falco recovers from normal, unaccelerated spins almost instantly by using full opposite rudder, power off and letting go of the stick. These test have shown the rudder to be so effective in recovering from a spin that the test pilots have been unable to detect any real benefit from using in-spin aileron. This does not mean that the aileron has no beneficial effect, just that the rudder is so powerful that any effect of the ailerons can barely be detected. Here is a report from an experienced Air Force pilot:

"In the Falco the rudder is so effective that it is all you should use to recover from a spin. If you let go of the stick you will notice that it will automatically go to the full aft position due to the relative wind striking the elevator and pushing it up. This will give you the most exposed rudder surface. The spin will be flatter, and there will be less angular momentum due to the the 'ice skater effect'; that is, the mass is distributed farther away from the rotating axis. I would not use aileron at all. They seem to have little effect in the Falco."

A former Navy carrier pilot filed this report: "The Beggs method works! I don't like it because I don't think it's as fast as old stop-the-rotation, break-the-stall and recover. However, most all of my spins have been induced on purpose, I know the direction, and the spins are upright. Also, I'm military trained—hard to teach an old dog new tricks. The Müller method works! I didn't feel the aileron made a dramatic increase in stopping the spin or decreasing the time of recovery. These are 'gut' feelings, and I did not use a stop watch or go more than two turns before initiating recovery. I have nothing against the methods but feel 'safe' with mine."

The spin tests by Falco builders have been in normal, unaccelerated spins only. While we agree that the rudder stops a normal spin so quickly that in-spin aileron doesn't make any detectable difference, we believe that in-spin ailerons will make a difference in accelerated spins. At this time, we are not aware of any spin tests in accelerated or flat spins in the Falco.

For our part, we hope that Eric Müller and Annette Carson will pardon the above quotation and plagiarism of their work, but the message is too important. Please get a copy of *Flight Unlimited*, and you will find 170-odd pages of some of the best instructions on acrobatics ever commited to the printed page.

Performance Testing

Performance testing involves a series of flight tests conducted for the purpose of determining the performance flight characteristics of the aircraft so that a series of charts can be drawn that will accurately predict the performance of the aircraft under various operating conditions. Because this process involves a large number of engineering calculations, we have written a computer program, *Benchmark*, which automates the process. The flight test methods are described in the Benchmark manual.

Benchmark runs on Macintosh computers and is available for $250.00 from Sequoia Aircraft Corporation, however *Benchmark* is available free of charge to any Falco builders who completes and flies his aircraft.