VELOCITY

Owner's Flight Manual

Standard & 173 Fixed and RG Aircraft

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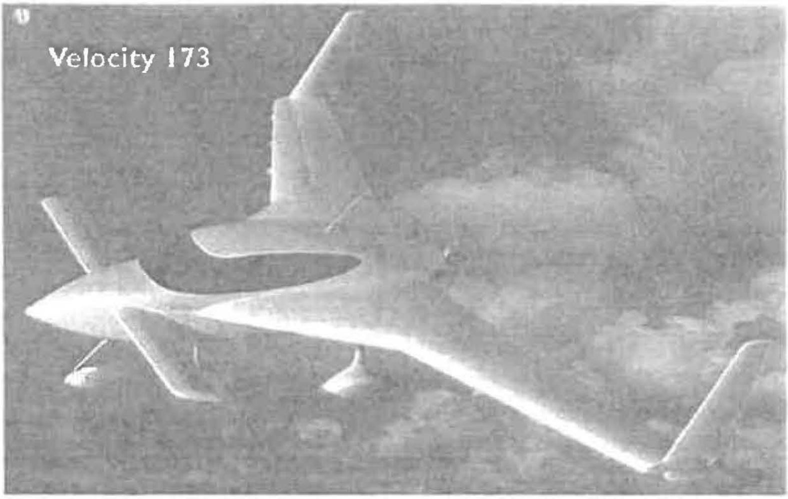


Registration Number: **N**
Built By
Address

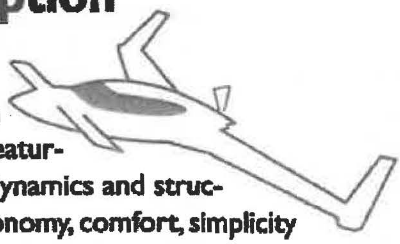
Date of Manufacture
Engine Manufacture Type
Serial Number
Total / SMOH Hours at Installation
Date of First Flight

Sold to
Address

Date Sold

Notes

General Description



THE VELOCITY is a modern, high performance custom built, long range aircraft featuring the latest advances in aerodynamics and structure to provide good utility, economy, comfort, simplicity and flight safety. The aircraft uses one of two proven certified aircraft engines, the Lycoming O360 (180HP) and the Lycoming IO360 (200HP). It has an alternator-powered electrical system and is equipped with electric engine starter. Its cockpit layout is designed to complement pilot work load, with throttle, mixture, carb heat, pitch trim and landing brake controls on the left console and side-stick controller in the center console. Seating provides correct armrest, lumbar, thigh, and headrest support, allowing comfort not found in conventional aircraft seats. This allows long, fatigue-free flights. The inboard portion of the large wing strakes are used as baggage areas, accessible from the front and rear cockpit. These, combined with special suitcases and other storage areas, provide nearly 10 cubic feet of baggage room. The design load factors of the Velocity are +12 G's/-9 G's with a tested airframe load of + 6 G's.

The Velocity aircraft uses the NASA-developed winglet system, which consists of an upper and lower cambered surface at each wing tip. These are designed to offset the wingtip vortex and reduce induced drag. The Velocity's use of one-way rudders in each winglet makes use of the winglet camber to tailor the rudder forces. This results in low forces at low speeds where rudders are used, and higher forces at higher speeds where rudders are not needed.

NOTE: The Velocity is not suitable/recommended for operations from unprepared surfaces: gravel, loose dirt or rough fields.

Dimensions	Standard Velocity		173 Velocity	
Wing Span/Area	29' 4"	121.8 sq.ft.	31'	145 sq.ft.
Canard Span/Area	164"	19.8 sq.ft.	188"	22.8 sq.ft.
Length	19'		19' 2"	
Height	7' 9"		7' 9"	
Cockpit Width				
Front	42.5"		43.5"	
Rear	42.0"		43.0"	
Cockpit Height				
Front	42.5"		42.5"	
Rear	38"		38"	

Weights

The normal equipped empty weight is approximately 1275 lbs. Actual weights for each airplane will vary according to installed equipment and builder workmanship. The maximum allowable gross weight for takeoff is 2250 lbs. (2400 lbs. 173 model) except as noted below. The strake baggage areas are structurally limited to 100 lbs. each side. The airplane can structurally accommodate pilots or passengers weighing up to 250 lbs. Actual limitations of each pilot area, each baggage area and fuel load depends on the empty weight and balance of the particular aircraft. Nose ballast may be required for light pilots.

Engine and Propeller

The Lycoming O-360 and the Lycoming IO360 engines are currently approved for use in the Velocity. The standard accessories – alternator, starter and vacuum pump – may be used. The Lycoming IO360, dynafocal mount is the most desirable engine. Both the Lycomings are suitable for pusher operations in this application. Both engines are currently in new production. However, the used/rebuilt engines are approximately one-half the cost of a new one. A partially run-out engine is generally preferred, due to the excessive cost of a zero-time engine.

Due to weight/balance and structural considerations, heavier or higher horsepower engines are not recommended.

Only the lightweight fixed-pitch wood and MT CS wood propellers are approved. Turbo charging and constant speed, variable pitch metal propellers are not recommended. Extensive development/testing would be required to qualify a metal prop for pusher application due to aerodynamic-induced vibration.

The modern wood prop uses a plastic leading edge to minimize rain erosion and has an efficiency close to the best metal prop, while offering a solution to the fatigue problem. Climb and cruise props are listed to the right. Note that the climb prop does not limit maximum speed. Max speed is fastest with the climb prop, but the engine turns faster than rated RPM at max speed.

Note: An RG may require 1 to 2 added inches of pitch

2 Bladed Prop	Engine	Prop Dia & Pitch
Cruise	180	68-70
Climb	180	68-64
Cruise	200	68-72
Climb	200	68-66
3 Bladed Prop	**Engine**	**Prop Dia & Pitch**
Cruise	180	66-72
Climb	180	66-68
Cruise	200	66-75
Climb	200	66-72

We prefer the "climb" prop, to obtain the best takeoff performance. Cruise at 60% power is at about 95% of rated RPM – our most used cruise condition. Cruise at 75% power (max cruise) results in an RPM of 100 to 200 over the engines rated RPM. With these light wood props, this overspeed condition is not detrimental to the engine when operating at less than 75% power (above 8000 ft., full throttle). The overspeed at max cruise can be eliminated by selecting a "cruise" prop, however takeoff performance and climb is effected as much as 25%.

NOTE: All the above sizes are for prop manufacturers who use the "flat bottom" as a pitch reference, which results in some "negative slip". If your prop manufacturer used the "zero lift line" as a pitch reference, add about six inches to the above pitch values. Some variance in pitch occurs with different manufacturers, to obtain the same prop load. Check with them before ordering.

Landing Gear

The Velocity features a tricycle landing gear. The main landing gear is a molded fiberglass/epoxy unit which gives exceptional energy absorption for bounce-free landing. For minimum drag penalty with fixed gear, the gear strut is molded into an airfoil shape, eliminating the need for superficial fairings. The wheels are streamlined with wheel pants.

The main landing gear uses Cleveland or Matco 6-inch wheels and brakes. A low-profile 15-6:00x6 (6:00 X 6 for 173 FG) 4 or 6 ply tire is used. The nose wheel is 5-inch diameter and uses a tire and tube.

Cockpit

Both front and rear cockpits are exceptionally comfortable. Semi-supine (reclined) seating is provided for optimum crew comfort. Pilots and copilots up to 6 feet 6 inches tall and passengers up to 6 feet 1 inch tall will find the cockpit quite comfortable. The canard configuration provides a wide cg range which allows for a full-size rear cockpit without passenger discomfort.

Full flight controls are provided for pilot and copilot. The wrist-action control stick is positioned on the center console, enabling the pilot and copilot to relax and rest the weight of their arm on the console, reducing the workload on long trips. Throttle, carburetor heat and mixture controls are found on the left side console.

The inboard portion of the large wing strakes are used as baggage areas, accessible from the front and rear cockpits. Small baggage, snacks, maps and navigation instruments may be stored in the front cockpit in two areas beneath the thigh support.

Due to the highly insulated fuselage structure, the Velocity will maintain comfortable inside temperature down to 0° OS using an oil cooler heat source. The requirement for cabin heat is far less than conventional light planes. Due to the cabin volume and good vent location, and tinted windows, the Velocity is more comfortable on hot days than conventional light planes.

Fuel System

The fuel system consists of two 30 gallon wing tanks. There is no provision for cross feed as fuel is used from both tanks simultaneously. A 6 gallon fuel sump (or 2.2 gallon in Elite option) is located behind the rear seat to assure fuel supply to the engine in normal flight attitudes. Each main tank and sump tank is vented. A mechanical engine-driven fuel pump transfers fuel from the sump to the carburetor or injector. An auxiliary electric fuel pump provides backup for the engine-driven pump. Fuel pressure is indicated on a gauge in the cockpit. The electric pump should be turned on if the engine-driven pump fails as noted by a loss of fuel pressure. The electric fuel pump should also be used to provide fuel pressure redundancy during low altitude operation, such as takeoff and landing.

There is one fuel drain on the airplane, under the fuel sump. CAUTION: Fuel additives should be checked for compatibility prior to use. Some fuel additives, such as MEK, or de-icing fluids like "Canned Heat", auto gas (especially the high aromatic content no-lead), should NEVER be used. They can dissolve the epoxy in the fuel tanks.

Control System

Pitch is controlled by a full-span canard slotted flap providing a large allowable cg range. Roll is controlled by conventional ailerons on the rear of each wing. The cockpit controls are similar to most aircraft with pitch and roll controlled by the side stick and two rudder pedals for yaw. The side stick controller is employed to give the pilot the smallest workload control arrangement possible. The rudders, located on the winglets at the wing tips, operate outboard only, providing two totally independent systems. The rudders are used for yaw control or can be deployed together as a mild speed brake.

Brake

Brakes are provided on the main wheels. They are used together for deceleration on the ground and individually for directional control at low speed on the ground. The brake actuating mechanism is the rudder pedal: after full rudder deflection is reached, the brakes are actuated. The brake master cylinder is the rudder stop. This system aids in keeping brake maintenance low by insuring that full aerodynamic control is employed before wheel brakes are applied.

Trim Systems

Cockpit-adjustable trim is provided for pitch and roll only. Yaw/rudder trim is ground adjustable only. Pitch and roll trim are electro/spring systems. Adjustable aerodynamic trim tabs are not used. The pitch and aileron switches are located on the left console. The pilot can safely override any trim setting even if it is stuck in an extreme position. The pitch trim can trim to hands-off flight from stall to maximum speed. This feature allows the pilot to land the aircraft using the pitch trim, rudders and throttle only. This is an excellent backup should a failure/disconnect occur in the normal control stick.

Landing Speed Airbrake

A drag device is used to allow a steeper approach and to provide more deceleration in the flare. This belly-mounted "speedbrake" is deployed by a switch on the left console or on the stick. It is normally extended on final and left down until after landing. Maximum speed with the airbrake down is 110 knots. The brake does not affect trim, stability, stall speed or stall characteristics. Climb should be avoided with brake down, as climb rate is reduced. The brake induces a mild buffet when down. During landing and taxi the landing brake down provides some prop protection from rocks being kicked up by the nose wheel.

Electrical Systems

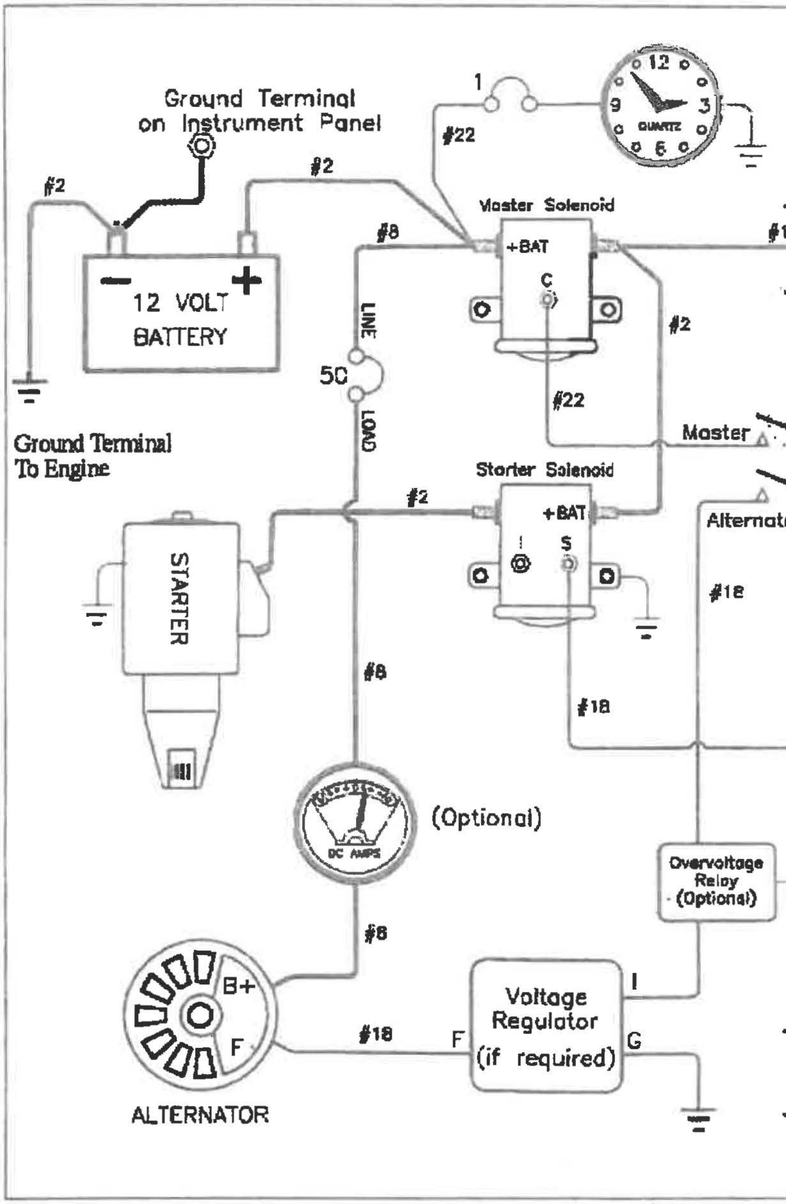
Refer to the wiring diagram (next page) that shows the basic electrical power distribution. NOTE: Any builder modifications should be noted on this diagram.

Normal Operations

This section covers the normal operating procedures for the Velocity. A summary checklist is provided for more convenient cockpit use.

Pilot Position

The Velocity was designed to accommodate tall pilots up to 6 feet 6 inches. Short pilots can fly the aircraft but they must sit on cushions to position their eyes in about the same position as tall pilots in order to have adequate forward visibility. The adjustable rudder pedals should be set in the aft position for short pilots and they should use cushions primarily under them, not behind them. If a short pilot uses a large cushion only behind him, he will be positioned forward and down because of windshield slant angle and will have inadequate forward visibility during climb and landing flare.


Ground Terminal
on Instrument Panel
#2
#2
12 VOLT
BATTERY
1
#22
QUARTZ
Master Solenoid
+BAT
C
#8
#2
LINE
50
LOAD
#22
Master
Ground Terminal
To Engine
Starter Solenoid
#2
+BAT
I
S
Alternato
STARTER
#18
#8
#18
(Optional)
DC AMPS
Overvoltage
Relay
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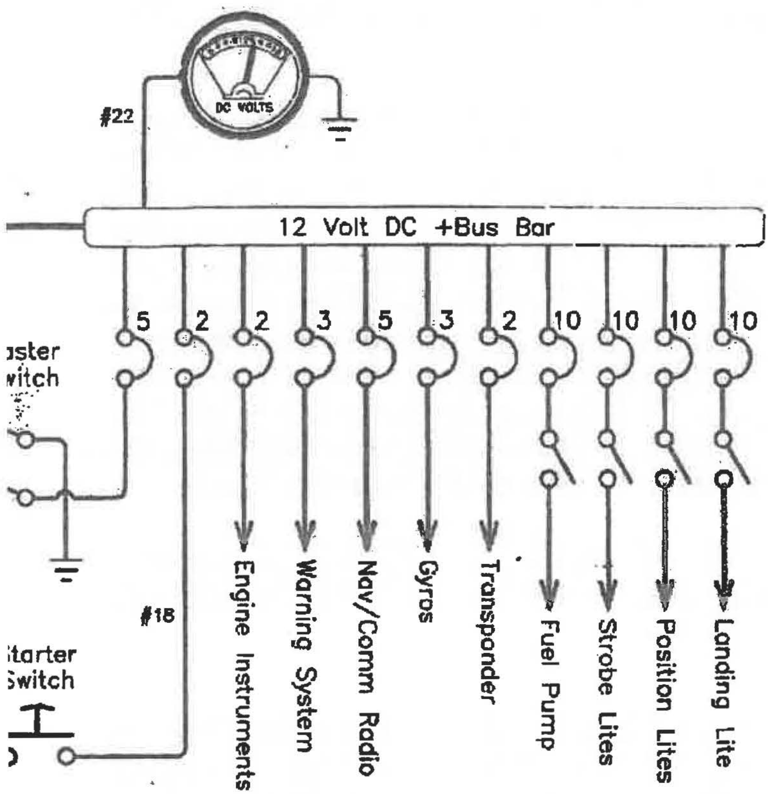
Regulator
(if required)
I
G
ALTERNATOR



Current Carrying Capacity for Stranded Copper Wire		
Gauge	Max Amps	Ckt Brkr
22	6	5
20	11	7
18	16	10
16	22	15
14	32	30
12	41	35
10	55	45
08	73	50
06	100	80
04	135	100
02	180	125

Velocity Inc.

TITLE Velocity Power Distribution Wiring Diagram

DRAWN BY	DATE	SCALE
Wayne Lanza	11/9/94	N/A
DWG # VELPWRIS	SHEET 1 OF 1	REV 0

CAUTION: Keep taxi speed slow on unprepared loose surfaces. The Velocity is more susceptible to prop damage than a conventional aircraft.

Steering below 25 knots (30 mph) is accomplished by applying full rudder and brake as required in the direction you wish to go. As you accelerate, the single pedal control will automatically shift you to rudder steering as the rudders become increasingly effective. The nose gear will free swivel, enabling you to maneuver in very tight places with ease. At low speed, steering is done exclusively with differential braking. The geometry of your Velocity makes it much less sensitive to upset than most aircraft; comfortable taxiing operations have been demonstrated in 40 knot crosswind components. Be careful to hold the stick while taxiing downwind so the "tailwind" will not damage the ailerons/elevator.

CAUTION: When taxiing with the canopy open, be careful that the wind does not slam it closed! Close and lock the canopy during windy conditions.

Takeoff

Complete your pre takeoff checklist. Check static RPM at full throttle. It must be at least 2400 for normal takeoff performance. Double-check that your canopy is locked down. Taxi forward a few feet to straighten the nose gear. Set pitch trim for takeoff.

Normal: Apply full throttle smoothly. As the aircraft accelerates, use rudder and brake as necessary for directional control. Maintain slight aft stick pressure as you accelerate to relieve the nose wheel. Rotate the nose gear just clear of the ground as soon as possible about 60 to 70 knots and hold the nose wheel just clear as you accelerate to about 75 knots. As you pass through 75 knots, rotate smoothly and you'll be off and flying. Add 5 knots if operating at heavy gross weight.

CAUTION: Never rotate the nose beyond the angle that places the canard on the horizon.

Crosswind Takeoff

During takeoff ground roll, with a crosswind component above 10 knots, you will find that wheel braking may be required long into the ground roll for directional control. In stronger crosswinds, you may require braking right up to rotation speed for directional control. The best technique is to hold full rudder but not to ride the brake continuously. Apply brake intermittently and allow the aircraft to accelerate between applications. The takeoff ground roll can be extended significantly (50% or more) by strong crosswind, especially at high gross weights and high density altitudes. The braking requirement for directional control is the reason for the takeoff limitation of 15 knots crosswind. Landings can be made up to a 20-knot crosswind component. CROSSWIND TAKEOFF TECHNIQUE: Hold aileron into the wind as you rotate for lift off. Let the aircraft accelerate above normal rotation speed and then rotate the nose abruptly to make a clean lift off without side-skip. For crosswind components above 10 knots add 5 knots plus one half the gust factor to the normal rotation speed. When clear of the ground make a coordinated turn into the wind to correct for drift.

Short Field Obstacle Clearance

Reduce gross weight as much as feasible and check the cg to insure it is not so far forward as to delay rotation. Be sure the engine is thoroughly warmed up and taxi to the very end of the runway. Align the aircraft with the runway, hold the brakes and apply full power. Release brakes and try to use minimum braking for directional control. Rotate to lift-off at 65 knots (light weight) or 75 knots (heavy weight). Maintain 80 knots best angle of climb speed, until the obstacle is cleared, then accelerate to normal climb speed.

Rough Field Caution: Although the Velocity may use the larger 600x6 tires, this does not make the aircraft totally suitable for rough, gravel or unprepared fields. Since the Velocity is a pusher, the aircraft cannot be rotated as easily as a conventional tractor aircraft. You still must accelerate to normal rotation speed 60 to 70 knots, depending on cg, before the nose wheel comes off and during this time the nose wheel can kick debris into the prop. The small nose wheel tire, high rotation speed and prop damage possibility makes the Velocity less suitable for unprepared field operation than a conventional aircraft.

However, if you must use an unprepared surface, reduce gross weight as much as feasible and adjust the cg as far aft as practical(within limits) to allow an early rotation. Do not use high power with the aircraft stationary, do the mag check on the roll if necessary. Hold full aft stick and apply power gradually to start the aircraft rolling before coming in with full power. This technique will help minimize prop damage. As the nose raises, the elevator should be eased forward so the nose wheel is held just clear of the ground. Accelerate and lift-off at the normal speed and accelerate to the desired climb speed. Do not try to "jerk" the aircraft off prematurely; this only places the prop closer to the ground and increases the chance of damage.

High Density Altitude

At density altitudes above 5000 ft., follow the normal takeoff procedures and (1) lean the engine for best power during run up, and (2) let the aircraft accelerate to 75 to 80 knots, then smoothly rotate and lift off.

Climb

For optimum rate of climb, maintain 100 knots. Best angle of climb is obtained at 80 knots. For better visibility and improved cooling, a normal cruise climb of 110 knots is used.

Caution: The altitude capability of this aircraft far exceeds the physiological capability of the pilot. Use oxygen above 12,500 ft.

Cruise

Maximum recommended cruise power setting is 75%. A high cruise power setting (full throttle at 8000 ft. density altitude) will result in the maximum true cruise speed. However, to take the best advantage of range and fuel economy, you may find that cruise power settings as low as 45% get you to your destination faster by avoiding fuel stops. Cruise at 60% power is the best compromise, providing good speeds and significant lowering of engine noise over 75% power. Lean your fuel mixture for best economy at cruise. Below 75% power, lean mixture until a very slight RPM loss is noted (20 RPM max). This approximates peak EGT setting for optimum lean mixture. Note that best range is obtained at a very low speed.

A good thumb rule for choosing an economical cruise power setting is to cruise at the same RPM that you get during a full-throttle static run-up before takeoff.

Maneuvering speed is 140 knots indicated. Remain below this speed in rough air.

Once at cruise altitude in smooth air, trim the aircraft to allow hands-off cruise. It is much less fatiguing to fly by using an occasional shift of the body weight or an occasional small adjustment of the trim knobs than to fly by continuously holding the stick. After a little practice setting trims, you will find you will be doing most of your flying, including climb and descent, without holding the stick. The rudder pedals are designed to allow the taller pilot to tilt his feet inward and relax them in a stretched-out position in front of the rudder pedals. This places the weight of the thigh on the thigh support, rather than the tail bone, and greatly increases comfort on long flights.

Leaning for Cruise

Few pilots realize the extent of fuel economy benefits available when an engine is leaned to proper "best economy" (BE) settings. Due to cooling requirements, BE setting (50° F of leanside of peak EGT), is allowed only below 65% power. Lycoming supplied data shows that at BE, specific fuel consumption is 14% lower than at "best power" leaning (approximately 90° F on rich side of peak EGT). A pilot that cruises at full-rich is not only damaging his engine and fouling plugs, but is burning up to 55% more fuel than at the BE setting! Always lean at least to peak EGT when cruising with less than 65% power.

Descent

You will find that your Velocity has such good climb performance that you routinely use higher cruising altitudes to avoid turbulence discomfort more often than with most light aircraft. It is not unusual nor inefficient to climb to 12,000 ft. altitude for a 150 mile trip. Bearing this in mind, you want to plan your descent into your destination enough in advance so that you do not find yourself over your destination with 10,000 ft. of altitude. The Velocity is a clean airplane and even with power at idle it may take 20 minutes to land! Using the extra altitude for a cruise descent speed advantage will get you there a lot sooner. Do not forget to reduce power slowly to avoid rapid cooling of the engine. Partially richen mixture when descending. Start your descent about 6 miles from your destination for every 1000 feet of height to lose, to arrive at pattern altitude.

Landing

Make your approach and traffic pattern very cautiously. Most pilots and controllers are accustomed to looking for more conventional aircraft of gargantuan proportions (like Cessna 150's) and may ignore you completely. Best pattern speed is 85 to 90 knots, slowing to 80 knots on final approach (85 to 90 in turbulence or gusty winds). The Velocity is a very clean airplane and you can double the runway length required if you are 10 or 15 knots fast on your approach. <NOTE: for the 173 model, these speeds are reduced by 10 knots>.

Deploy the landing brake on final to obtain a normal glide path angle comparable to conventional aircraft. Failure to use the land-

ing brake will result in a flat/wide pattern, more difficult airspeed control and the probability of overshooting your desired touch-down point. Make a complete flare and touch down at 70 to 75 knots. The normal landing technique of holding the nose off to minimum speed should not be used in a Velocity. Make a complete flare, then fly it down to touch down. This avoids a common tendency to flare too high. It is better to land a bit fast on your first attempts than to run out of airspeed while 10 feet in the air. Maintain a slightly nose high attitude as you roll out and use aft stick to ease the loads on your nose wheel during heavy braking. While the landing gear is strong enough for rough surfaces, the small tire diameters will give the crew a harsh ride. This, combined with the 70 knot touchdown speed, makes a hard surfaced runway much more pleasant. If you need to land on a rough field, hold the aircraft off to minimum speed and keep the nose high as long as possible.
Caution: NEVER flare beyond the angle that places the canard on the horizon.

Crosswind landings may be flown several ways. Slight crosswinds are easily handled using the wing-low sideslip approach. Another method is to simply land in a wings-level crab. The landing gear design makes this technique safe and easy. The best method for strong gusty crosswinds is to approach in a wings-level crab and straighten the nose with the rudder immediately before touchdown. Be careful to not lock a wheel brake (full rudder) at touchdown. DO NOT SLIP OR CROSS CONTROL A VELOCITY IN STRONG GUSTY CONDITIONS! Why? First, you could stall a winglet. Second, when slipping an a/c with swept wings, the wing opposite the direction that the aircraft is being slipped is more perpendicular to the relative wind. This gives the leading wing more leverage and lift than the trailing wing, thus allowing the possibility that the aircraft could be forced into a stall during exaggerated cross control and slow flight. Third, with the majority of the fuselage being forward of the wings, there is a chance that the fuselage could blank out the wind to the trailing wing. The Velocity has demonstrated taxi, takeoffs and landings in gusty winds to 45 knots and with crosswind components as great as 18 knots for takeoff and 28 knots for landing.

Fly from long runways until you develop your proficiency. A 2000 ft. runway length can be considered as minimum, but only after you have made at least 50 landings on longer runways.

Caution: If the cg is aft, it is possible to rotate the nose to an excessively high angle during landing rollout, placing the cg aft of the main wheels. Avoid rotation above 12 degrees (canard on horizon), using forward stick or brakes as necessary, to avoid prop damage or tipping the aircraft onto its tail.

Ground Handling and Tie Down

The easiest way to handle the aircraft on the ground is to stand in front of the canard and grasp its top surface with one hand and the elevator slot underneath with the other hand. Do not handle the elevator.

The Velocity can be safely left unattended in moderate winds. However, it is prudent to always tie down any aircraft whenever possible. For long term parking, position the Velocity backwards in the parking slot, with the nose over the normal tail tie down rope. "Set" the main gear and securely tie down the wings. Position the nose just to the right of the "tail" tie down and tie the nose securely to the ground.

If your aircraft is subject to being moved by unknowledgeable people, ballast the nose and attach a sign to caution them about the possibility of gear creep and loss of alignment.

Stall and Low Speed Handling Characteristics

The Velocity has good flight characteristics at minimum speed. It is a docile, controllable airplane at full aft stick at its minimum airspeed of 65 to 70 knots. It does not exhibit any of the conventional airplane's tendencies to roll or pitch down uncontrollable or other common uncommanded flight path excursions. Any power setting may be used at full aft stick without changing the way the airplane handles. By adjusting the throttle setting you can climb, descend or maintain level flight. The very low speed range (below 65 knots) is characterized by a doubling of the force required to hold the stick aft, tending to keep the inattentive pilot at a more normal flying speed. Ailerons and rudder are effective at all speeds, including full-aft stick flight.

Since the flight characteristics of the Velocity are so much better at minimum speed than contemporary conventional aircraft, it hardly seems fitting to use the term "stall" in characterizing the Velocity behavior, even though it is technically correct. The Velocity's "stall" consists of any one of the following, in order of prevalence:

1. Stabilized flight (climb, level or descent, depending on power setting) at full aft stick. Below 65 knots there is a very definite increase in the aft stick force, such that the pilot has to pull noticeably harder on the stick to get below 65 knots.

2. Occasionally, particularly at forward cg, the airplane will oscillate mildly in pitch after full aft stick is reached. This is a mild "bucking" of a very low amplitude, one to two degrees and about one-half to one "bucks" per second. If the full aft stick is relieved slightly, the bucking stops.

At any time during the "stall", power can be set at any position, or changed to full or idle, without affecting the stall characteristics. There is a small roll trim change due to power and very slight pitch trim change, but neither affect the aircraft's controllability at sustained full aft stick.

Accelerated stalls to 3 g and steep pulls to 60° pitch (minimum speed 65 knots) can be done at full aft stick without any departure tendency.

Intentional spins have been attempted by holding full aft stick and using full rudder, with all combinations of aileron control, and at all cg positions. These controls were held through 360° of rotation. Full aft stick and full pullup results in a lazy spiral, which ends up in a steep rolling dive at 3 + g and 100 knots. At any time, the spiral can be immediately stopped by removing rudder control and a completely straight forward recovery can be made. That maneuver is not a spin, since at no time is the aircraft departed from controlled flight. If the above maneuver is done at aft cg, the rotation rate is higher so the lazy spiral is more of a slow snap roll. However, even at aft cg the recovery is immediate when controls are neutralized.

You are cleared to do stalls in your Velocity in any power, trim or landing condition within the normal operations envelope. Intentional spins (or attempts to spin) are not approved.

NOTE: Experience with the Velocity has shown that some variance in stall characteristics may be expected from one airplane to another. Inaccurate airfoil shapes, incidence errors, or errors in weight and balance can result in a degradation of the normal safe stall characteristics. Aft of the aft cg limit, the Velocity may be susceptible to aft wing stall, which, while recovered with the forward stick, can result in a stall break with high sink rate. If any of your aft cg characteristics are undesirable, adjust your cg limit forward accordingly.

Emergency Procedures

FIRE

There are normally only two sources of aircraft fires: electrical and fuel. In the event of fire on the ground, kill all electrical power and stop the engine. Clear the aircraft. Use a carbon dioxide type extinguisher. For inflight fire, determine the cause: if electrical, all electrical power off; if fuel, stop the engine. Turn the cabin heat off and open the cabin air vent. Execute a precautionary landing as soon as possible.

ENGINE FAILURE

Modern aircraft engines are extremely durable and seldom fail catastrophically without plenty of advance warning (lowering oil pressure, excessive mechanical noise, rising oil temperature, etc.). Pilot induced failures, on the other hand, are far more common (carburetor ice, confusion of mixture and carb heat controls, fuel starvation, fuel management, etc.). In the event of inflight engine stoppage, check mixture - RICH, boost pump on, magnetos - BOTH, and attempt restart. If the engine begins to run rough, check for induction icing, improper mixture setting, or a bad magneto. If carburetor heat or an alternate magneto setting fail to correct the roughness, make a precautionary landing as soon as possible and trouble-shoot. Lowering/rising oil pressure, rising oil temperature or increasing mechanical noise are good indications of impending failure and flight should be aborted as soon as possible. Do not hesitate to declare an emergency to obtain priority clearance. If stoppage does occur and restart is impossible, execute the engine-out approach and landing.

In case of engine failure, the engine will probably windmill above 80 knots. However, as the engine cools down, a higher speed may be required to maintain engine rotation. With some engines/props a glide speed as high as 100 knots may be required. Windmilling RPM decays slowly enough to give the pilot time to increase his speed to maintain rotation. Once the prop stops, a speed of 130 knots or more is required to regain rotation (2000 ft. altitude loss). This may be 180 knots/4000 ft. for the high compression IO360. The pilot should determine when it is no longer feasible to attempt restart, since the best glide angle speeds may be lower than windmill speeds (best glide distance may be done with prop stopped).

ENGINE OUT APPROACH

If an engine-out landing is unavoidable, check wind direction, choose your landing area and establish your glide at 90 to 100 knots. Remember that with the engine out and prop windmilling, your glide will be considerably steeper than the normal engine-idle glide that you are accustomed to. If you are radio equipped, tune in 121.5 and declare an emergency and give your intended landing site. Set up the forced landing pattern with the landing brake out and shoot for the middle 1/3 of the forced landing area. Turn your electrical power and mags off before touchdown to minimize any potential fire hazard. Touchdown as slowly as possible if landing in rough terrain.

INFLIGHT DOOR OPENING

Door opening in flight is a serious emergency. Should the door come fully open 90° in flight, immediately grab the rail/handle and pull the door down. Be sure to maintain aircraft control. Do not be so concerned with closing the canopy that you allow the aircraft to fly unnecessarily into the ground.

LANDING GEAR EMERGENCIES

The only gear emergency to be considered in a fixed gear Velocity is a flat tire. Landing with a flat/blown main tire: make a normal landing touchdown near the side of the runway with the good tire. Use ailerons to hold the weight off the flat tire. Lower the nose and use brakes for directional control. Never attempt to takeoff with a flat tire.

A gear down emergency in the **"RG"** requires that the pilot determine if the emergency is:

1) electrically related;
2) hydraulically related; and
3) mechanically related.

If gear fails to lock down, check circuit breaker if pump has failed to operate, and gear down lights to determine if a light has failed. If all check OK, cycle the "dump" valve to release hydraulic pressure to the electric pressure switches in the system. If the gear still fails to operate, place gear switch in "down" position, pull gear circuit breaker and place the dump valve in the "down" position. The gear should free fall in about 7 to 10 seconds to the down and locked position. If your down lights are wired to the gear circuit breaker, re-set the circuit breaker long enough to verify "gear down". If either gear light fails to light, a visual check of the main gear overcenter linkage is in order. The nose gear overcenter can be verified by reaching over the extended center console and "feeling" or "helping" if necessary the nose gear linkage to lock. A 1" hole can be drilled just below the O.C. linkage in the pilot side side center consol (keel) for an easy check of the O.C. linkage.

If the gear pump continues to run but the gear does not extend, pull circuit breaker and proceed with dump valve as above.

If a mechanical problem is causing a gear to "hang up", determine the cause and do what is necessary to "break loose" whatever is causing the hang-up. A sudden pull-up (slow to maneuvering speed) may be necessary to free a stuck wheel or a jammed cable. A gear up landing should be made as a last resort. Once gear down lights are indicated, re-position the dump valve to the normal position. This will "lock" hydraulic pressure in the system.

WHEEL BRAKE FAILURE

Since the brakes are the only means of directional control after the aircraft decelerates below about 35 knots, landing with a brake out poses a special kind of problem. The risk of damage can be minimized by considering the following: If possible, select a long runway with a crosswind from the side of the failed brake. The aircraft will weather-vane into the wind and, by careful application of the good down-wind brake, directional control can be maintained.

Limitations

Install the following placards in the cockpit, visible to the pilot:

Max Landing Brake Extension Speed	110 knots
Gear Extension	120 knots
Min Pilot and Co-pilot Weight	xxxx lb.
Max Pilot and Co-pilot Weight	xxxx lb.
(Determined by weight & balance)	

MANEUVER	RECOMMENDED ENTRY
Candelles	130 knots (150 mph)
Lazy Eights	130 knots (150 mph)
Steep Turns	130 knots (150 mph)
Stalls (except whip stalls)	Slow deceleration
Accelerated Stall	110 knots (126 mph)

Intentional spins are not permitted.

Crosswind Component	15 knot takeoff, 20 knot landing
Maximum wind for taxi (all quarters)	40 knots (46 mph) - door(s) closed
Red Line Speed	200 knots
Maneuver Speed	140 knots
Maximum Gross Weight	2250 lb. (2400 lb for 173)
Center Gravity Limits	fwd: 115.0 aft: 121.5

Engine Limitations *	
Lycoming O-360 & IO360:	
RPM	2700 max
CHT	450 max
	435° continuous
Oil Temp	245° max
	180° desired
Oil Press.	60-90 psi normal
	25 psi idling
Fuel	100 octane

* Refer to your specific engine's operator's manual for detailed operating instructions

Pilot Experience Requirements

Pilot Checkout

There is no such thing as a minimum number of total hours a pilot should have to be qualified for checkout solo in a new aircraft. The best pilot qualification is variety. He should be current in more than one type of airplane. The Velocity is not difficult to fly, but it is DIFFERENT: like a Yankee is different from a Cessna, or a Cub is different from a Cherokee. A pilot who is used to the differences between a Cessna and a Cub is ready to adapt to the differences in a Velocity. The Velocity has entirely conventional flying qualities. However, its responsiveness is quicker and its landing speed is faster than most light training aircraft. It should not be considered as a training airplane to develop basic flight proficiency. The Velocity ranks with the best tricycle-geared types for ground stability and has none of the ground-looping tendencies of the taildraggers.

The requirement for a variety of experience applies to checkout in any type of new aircraft, not only to Velocity. Velocity has never experienced a problem in checking out a new Velocity pilot. We always follow the criteria listed here for initial pilot checkout and strongly recommend that you do:

1. Checkout should not be done in gusty winds, particularly crosswind conditions.
2. Use runway at least 3500 ft. long for initial checkouts. The beginning Velocity pilot often finds himself fast on approach and the airplane is so clean that it is easy to use up a lot of runway in the flare.
3. Give the potential pilot a copilot ride or two. This gives him a first-hand look at the aircraft's performance envelope and general flying qualities. Trim the airplane up and let him "fly" it from the right seat by leaning back and forth. This will give him an appreciation of the airplane's sensitivity. Show him the use of the trim systems (pitch and roll). Let him get used to the pitch and roll feel. Do not transition him to the left seat unless he flies the aircraft smoothly and confidently from the right seat. Do not have him fly solo on his first flights until he has the hang of it.
5. Weight and balance must be in the first flight box.
6. Briefing must emphasize that the aircraft should never be rotated past the angle that places the canard on the horizon for takeoff or landing.
7. Pilot being checked out must have a minimum of 10 hours each in at least two type aircraft in the last 4 months (5 in the last 30 days) and feel competent and comfortable in them during marginal conditions, such as crosswind landings near demonstrated limits, etc.

Initially some of the pilots checked out by Velocity tended to do the following on their first takeoff: immediately after liftoff, they would level off or descend, then re-establish a normal climb. We have found that this is caused by the unusual visual cue provided by the canard wing. Even though the climb angle is similar to other light planes, the canard wing gives the pilot the impression that he has over-rotated. Since we found this was the cause, we have told pilots the following and have found that the pitch "bobble" no longer occurs: rotate smoothly to liftoff at 75 knots. If you think you have over-rotated, do not overreact; do not shove the stick forward. Hold the liftoff attitude and the airplane will accelerate to 85 knots for climb.

Occasionally, a new Velocity pilot will tend to make a "full stall" landing or flare too high. Tell him that if he has made the approach at the correct speed and pulls power to idle before the flare, he should not spend a lot of time in the flare. Make a complete flare, then fly the airplane down onto the runway with finesse. Once the main wheels make contact, continue to fly the canard and lower the nose when speed allows.

Weight and Balance

You must have completed the last chapter ("Final Assembly Section") of the Builder's Construction Manual prior to performing the lofting and weight & balance ("w&b") on your newly constructed Velocity. This is a critical procedure! An aircraft which is operated out of its CG envelope is an accident waiting to happen. So enlist some capable help, procure proper scales (you can rent certified scales), and measuring equipment, and perform each of the following procedures carefully (double check each step to be safe).

Here is what you will need:

- 3 "certified" scales (1 at least 300#, 2 at least 650#)
- 50' tape measure
- 12' tape measure
- Plumb bob & stand
- Shims and chocks for the wheels
- Stepladder or stool

• Wing and canard incidence jigs
• Water level, or a good 6'-8' level

Step 1 - Leveling the aircraft:

Locate a cement floor that is as flat and level as possible. The aircraft must be level for the procedure, so you will use shims under the wheels to help get it level.

Using your wing incidence jig, level the aircraft fore and aft to 0° wing angle. Next, check the canard incidence with the canard jig. It should also be 0°.

Position a level on the rear of the upper fuel strake, just above the main spar. The length of the level should run inboard to outboard. Use it to level the aircraft from right to left. This area of the strake is not exactly level, so use shims to average it out. Now check the level against the canard, which should be level as well.

Step 2 - Lofting measurements needed for static CG:

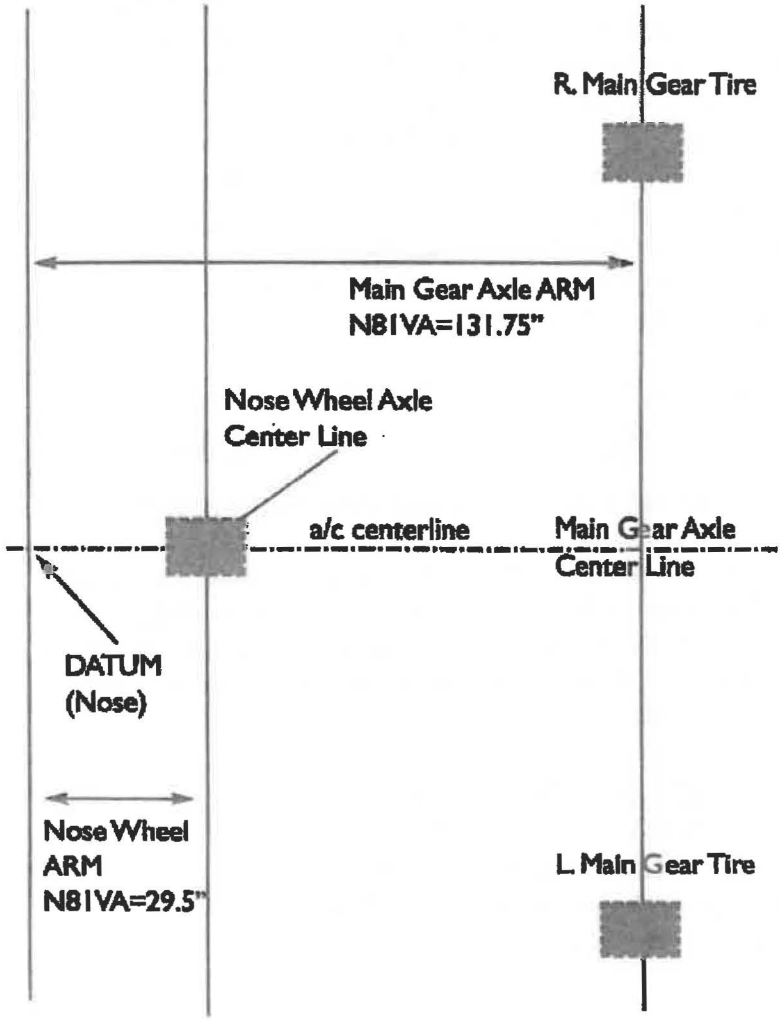
Once the aircraft is level, get out the plumb bob, some 2" masking tape, and a sharp point marker pen. The tape goes on the floor to receive the mark from the plumb bob, as well as the identification marks. Record measurements for all those indicated by blank spaces on diagram OM-CL. Enter your measurements in the blanks next to the measurements for the factory aircraft "N81VA", which is a Standard Velocity. Some dimensions may vary slightly, and will have to be taken into consideration when calculating the CG box for you Velocity.

There are three critical dimensions for calculating your static CG, shown in diagram OM-CL (looking down on the aircraft). They are:

• Nose "datum of aircraft"
• Nosewheel axle (when trailing)
• Main gear axles (average if different)

Step 3 - Weighing your Velocity:

Diagram OM-CL



Your ARM =	Your ARM =

The aircraft should be ready to fly, with oil, but NO FUEL. All accessories should be installed prior to w&b.

NOTE: If your Velocity is in primer stage (ie. no finish coat yet), then you will need to repeat the w&b procedure after final paint coat is on. We have found that the final coat adds about 16 lbs and generally shifts the CG aft slightly.

To weigh the aircraft, level it while on the three scales (light duty scale goes under the nose wheel, with the other two under the main wheels) fore and aft, right and left. NOTE: It is critical that you level the aircraft prior to w&b!

Record each individual scale reading, then record the combined total. Record each weight below:

Left Main Wheel Weight = Right Main Wheel Weight =

Nose Wheel Weight = Combined Total Weight =

Step 4 - Weights for Calculating Pilot/Co-pilot ARM for your Velocity:

Have a friend handy that you have pre-weighed on one of the certified scales (obviously if you only have three certified scales, do this prior to step 3). Record his weight below. Have him sit in the pilot's seat. Now record the aircraft weight from each scale, then the combined total.

Pilot Weight (friend's exact weight) =
Nose Wheel Weight (with Pilot) =
Left Main Wheel Weight (with Pilot) =
Right Main Wheel Weight (with Pilot) =
Combined Total Weight (with Pilot) =

This information will be needed to calculate the pilot ARM for your Velocity.

Step 5 - Weights for Calculating Rear passenger ARM for your Velocity:

Have the same friend sit in the rear passenger's seat. Now record the aircraft weight from each scale, then the combined total.

Pilot Weight (friend's exact weight) =
Nose Wheel Weight (with Rear Passenger) =
Left Main Wheel Weight (with Rear Passenger) =
Right Main Wheel Weight (with Rear Passenger) =
Combined Total Weight (with Rear Passenger) =

This information is needed to calculate the Rear Passenger ARM for your Velocity.

Step 6 - Weights for Calculating Fuel ARM for your Velocity:

With no people in the aircraft, add enough fuel to fill only the header fuel "sump" tank (standard holds 6 gallons or 36 lbs, and the new Elite one holds 2.2 gallons or 13.2 lbs). Now record the aircraft weight from each scale, then the combined total.

Header Fuel Tank Weight (@ 6 lbs per gallon) =
Nose Wheel Weight (with Header fuel tank full) =
Left Main Wheel Weight (with Header fuel tank full) =
Right Main Wheel Weight (with Header fuel tank full) =
Combined Total Weight (with Header fuel tank full) =

Now bring the fuel up to 15 gallons (total fuel, including what is already in the header tank). Record the aircraft weight from each scale, then the combined total.

15 Gallons Fuel Weight (@ 6 lbs per gallon) = 90 lbs
Nose Wheel Weight (with Header fuel tank full) =

Left Main Wheel Weight (with Header fuel tank full) =
Right Main Wheel Weight (with Header fuel tank full) =
Combined Total Weight (with Header fuel tank full) =

Now bring the fuel up to FULL CAPACITY. Record the aircraft weight from each scale, then the combined total.

Full Fuel Capacity (gallons) =
Full Fuel Capacity Weight (@ 6 lbs per gallon) =
Nose Wheel Weight (with Full Fuel) =
Left Main Wheel Weight (with Full Fuel) =
Right Main Wheel Weight (with Full Fuel) =
Combined Total Weight (with Full Fuel) =

This information is needed to calculate the FUEL ARM for your Velocity.

STEP 7 Establish the Static CG of your aircraft:

Here is the text description:
•A: Nose wheel weight multiplied by the nosewheel axle ARM
•B: Mains total weight multiplied by the mains axle ARM
• Add the sum of A + B, divided by the total aircraft weight
= Static CG position

Here is the formula version (same outcome as above text version) to obtain Static CG position:

$$\frac{(\text{Nose Wheel Weight X Nose Axle ARM}) + (\text{Mains Total Weight X Mains Axle ARM})}{\text{Total Weight of Aircraft}}$$

When you multiply a weight by an ARM (distance), the result is called a moment, and is expressed in units called INCH LBS.

Therefore, in order to simplify our calculations, the preceding formula will be referred to as follows:
Here is an example using the factory Velocity N81VA:

$$\frac{\text{NOSEWHEEL MOMENT X MAIN MOMENT}}{\text{TOTAL WEIGHT OF AIRCRAFT}} = \text{STATIC CG POSITION}$$

Nosewheel Axle ARM = 29.5"
Nosewheel weight = 73 lbs
Main gear axle ARM = 131.75
Main wheels (L+R) combined weight = 1205 lbs (604 + 601)
Total Weight = 1278 lbs

$$\frac{(73\text{x}29.5) + (1205\text{x}131.75)}{1205 + 73} = 125.9 \text{ inches aft of datum (Static CG)}$$

$$\frac{2153.5 \text{ in lbs} + 158759 \text{ in lbs}}{1278} = \frac{160912.5 \text{ in lbs}}{1278} = 125.9 \text{ inches aft of datum}$$

Step 8 - Calculating the various ARMs

It will be necessary for you to calculate the ARM for each of the following:

- "Pilot/co-pilot" ARM
- "Rear passenger" ARM
- "Header sump tank fuel" ARM
- "Fuel" ARM
- "Baggage" ARM

Here is an example using the factory Velocity N81VA to calculate the "Pilot/co-pilot" ARM:

Nosewheel Axle ARM = 29.5"

Nosewheel weight = 157 lbs
Main gear axle ARM = 131.75
Main wheels (L+R) combined weight = 1282 lbs (622 + 660)
Pilot Weight = 161 lbs

• **First**, find the CG of the aircraft with pilot:

$$\frac{(157 \times 29.5) + (1282 \times 131.75)}{1282 + 157} = \frac{173535 \text{ Inch lbs}}{1439 \text{ lbs}} = 120.59"$$

• **Second**, subtract the moment of the empty aircraft (160912.25 inch lbs) from the moment of the aircraft when loaded with the pilot (173535 inch lbs)
173535 - 160912.25 = 12622.75 inch lbs

• **Third**, verify that the weight difference between the aircraft with pilot (1439 lbs) and the weight of the empty aircraft (1278 lbs) equals the pilots weight (161 lbs).

• **Fourth**, divide the difference of the moments by the difference of the weights (the pilot weight), and the result will be the "Pilot/co-pilot" ARM:

$$\frac{12622.75 \text{ inch lbs}}{161 \text{ lbs}} = 78.4\text{" aft of datum}$$

Repeat this procedure for all the various ARMs and record the results below:

• "Pilot/co-pilot" ARM =
• "Rear passenger" ARM =
• "Header sump tank fuel" ARM =
• "Fuel" ARM =

• "Baggage" ARM =
• "Ballast/Nose" ARM =

Note: For the fuel ARM, add the two Fuel ARMs (15 gal + Full), divide by 2 to get an average Fuel ARM

Here are some sample ARMs for N81VA:
• "Pilot/co-pilot" ARM =78.4
• "Rear passenger" ARM =119.13
• "Header sump tank fuel" ARM =135
• "Average Fuel" ARM = 122.25
• "Baggage - wing strakes average" ARM = 105
• "Ballast in nose" ARM = 29.5

Step 9 - Calculating the CG now that you know the ARMs for your aircraft:

Ok, now we have all the data we need to set up a weight & balance worksheet. You can set up a worksheet using a computer with spreadsheet software (eg. Excel, Lotus, etc.) or simply make photocopies of the worksheet (OM-WB) and do it longhand. Refer to the "sample only" weight & balance spreadsheet for a "standard" Velocity.

It is pretty much self explanatory after all that you have been through to get this far, but to be safe, let's run through it. First, if you are setting up this template on a computer, as a test plug in the above sample numbers to make sure that your cell formulas agree. Then go ahead and input your numbers for your Velocity.

Now, let's run through the worksheet using the numbers from the previous sample. Multiply each "Weight" by the corresponding "ARM", and enter the total in the column to the far right. Next, add the total weights and enter it on the bottom row "Total" under the "Weight" column (2249 lbs). Now add the total Moment and enter it on the bottom row "Total" under the "Moment" column (263667.60 inch lbs). Last step is to divide the

SAMPLE ONLY Standard Velocity		Fuel Gallons	Weight LBS	ARM Aft Datum (Inches)	Moment (In lbs)
Basic Empty			1278	125.91	160912.25
"Sump" Tank Fuel	6	6	36	135.00	4860.00
Fuel (@ xx gals)	6	50	300	122.25	36675.00
Pilot & Co-pilot			305	78.40	23912.00
Passengers (rear)			295	119.13	35143.35
Baggage (wing strakes)			15	105.00	1575.00
Ballast (nose)			20	29.50	590.00
TOTAL			2249	117.24	263667.60

	MAXIMUM	ACTUAL
Gross Weight =	2250	2249
Usefull Load =	972	971
C.G.	120.75	117.24

	A	B	C	D	E	F
1	OM-WB					
2	WEIGHT & BALANCE WORKSHEET		Fuel	Weight	ARM Aft	Moment
3			Gallons	LBS	Datum (Inches)	(in lbs)
4						
5	Basic Empty					
6	"Sump" Tank Fuel	6				
7	Fuel (@ xx gals)	6				
8	Pilot & Co-pilot					
9	Passengers (rear)					
10	Baggage (wing strakes)					
11	Ballast (nose)					
12						
13	TOTAL					
14						
15				MAXIMUM	ACTUAL	
16	Gross Weight =					
17	Usefull Load =					
18						
19	C.G.					

SAMPLE ONLY

Standard Velocity		Fuel Gallons	Weight LBS	ARM Aft Datum (inches)	Moment (in lbs)
Basic Empty			1278	125.91	160912.25
"Sump" Tank Fuel	6	6	36	135.00	4860.00
Fuel (@ xx gals)	6	20	120	122.25	14670.00
Pilot & Co-pilot			190	78.40	14896.00
Passengers (rear)			0	119.13	0.00
Baggage (wing strakes)			0	105.00	0.00
Ballast (nose)			25	29.50	737.50
TOTAL			1649	118.91	196075.75

	MAXIMUM	ACTUAL
Gross Weight =	2250	1649
Usefull Load =	972	371
C.G.	120.75	118.91

total moment by the total weight to arrive at the CG (117.24").

The blank worksheet (OM-WB) is there for you to use as a template for manual calculation. Make extra copies first. Enter all the known data first. Start with column E "ARM aft" and enter each ARM that you previously calculated for your aircraft. Next enter the Basic empty weight on Column D Row 5. Next enter the maximum gross weight on column D row 16 (2250 for standard). Once all the known information is entered, make some extra photocopies. Know go ahead and figure in some weight and balance examples for your aircraft, just like we did in the previous sample.

You must complete weight and balance data and have it in your aircraft in order to pass an "FAA ramp check"! Remember the word "ARROW" as a reminder of what you need to keep in your aircraft. A= Airworthiness Certificate (along with Statement of Operating Limitations), R = Registration Certificate, R = Radio Station License, O = Operating Limitations, W = Weight & Balance data.

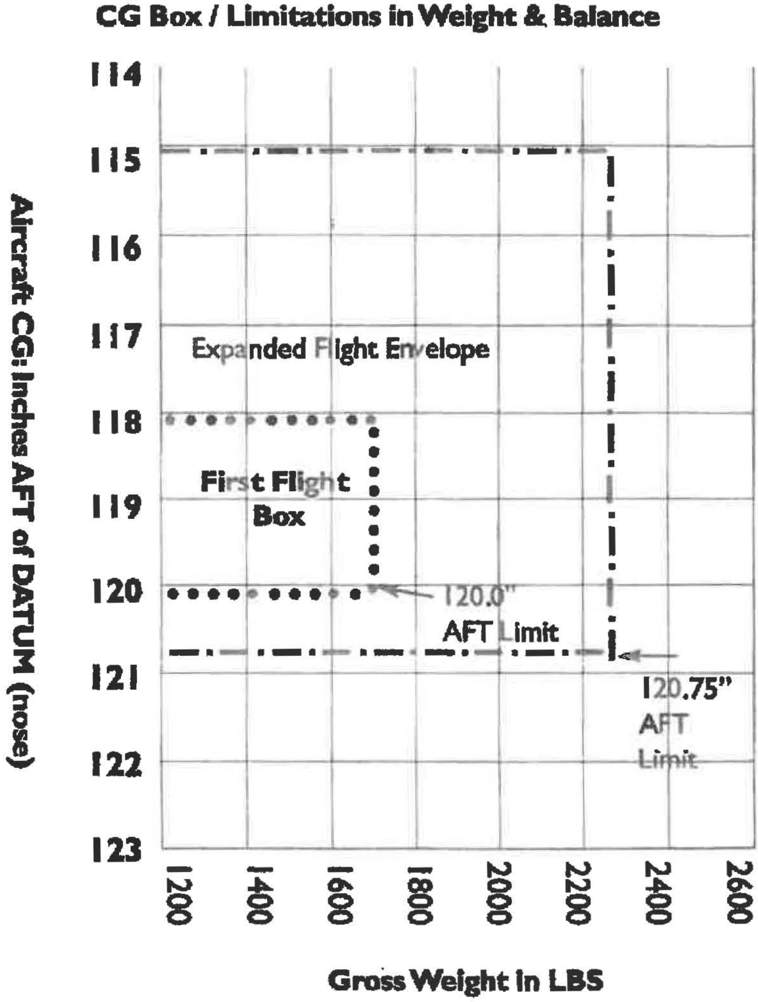
We recommend calculating a number of extreme w&b examples to leave as part of this Owners Flight Manual. Calculate many samples with low v. high fuel, fore v. aft CG limits, etc.
The following is another sample which falls within the "First Flight" CG & Weight box:

The CG Box:

When doing a w&b on your Velocity, you are actually working with a see-saw. The aircraft center of lift is the fulcrum, and the pilots, passengers, fuel and baggage are the riders. The idea is to maintain a balance between the center of lift and the center of gravity (CG). In ideal situations, the CG should be slightly forward of the center of lift. If the CG falls behind the center of lift, you will have an unstable aircraft which is potentially very dangerous in a stall situation. In canard aircraft, we always want the

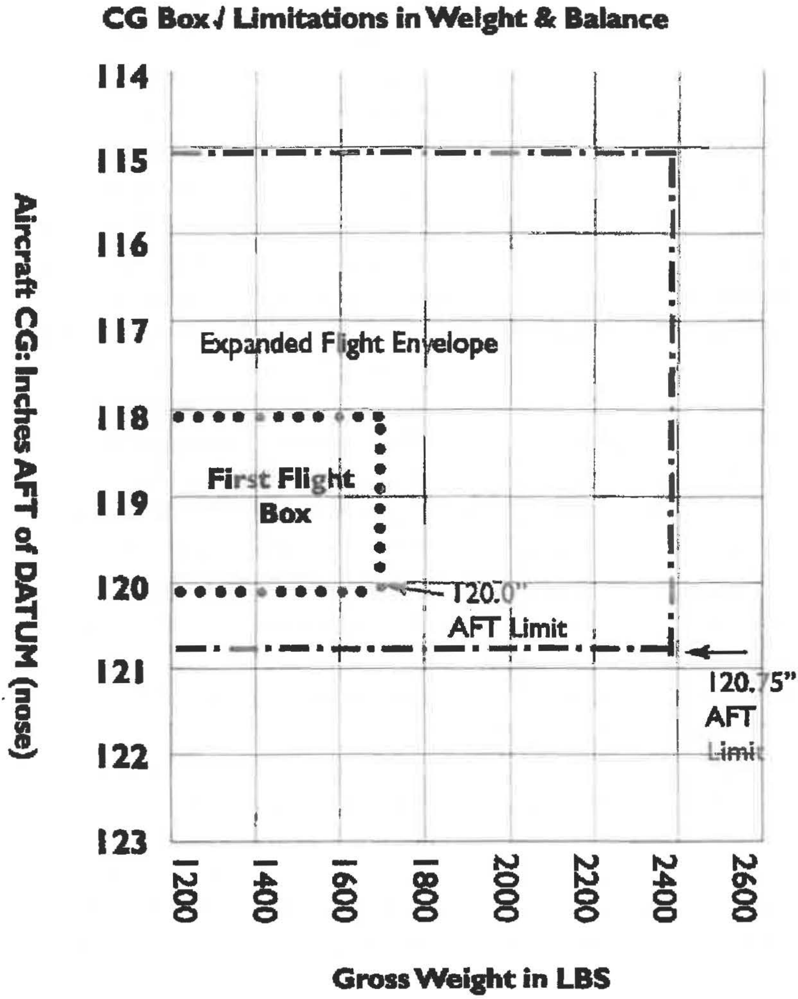
CG BOX

for Velocity Models with the STANDARD WING



VELOCITY

CG BOX
for Velocity Models with the
173 WING



canard to stall prior to the main wing, causing the nose of the aircraft to lower, and thus slightly accelerating the aircraft and maintaining normal controlled flight. All operations in this aircraft must be forward of the aft limit of your CG box.

Establishing the CG box for the Velocity has been done by the factory using flight testing and basic aerodynamics. The theory calls for maintaining a 2-to-1 loading on the canard versus the main wing. The canard is also flown at a much greater angle of attack than the main wing, thus inducing a stall in the canard first. If either one or both of these rules are broken, the result will be an extremely dangerous aircraft. So always, operate your aircraft within the prescribed CG box. The centers of lift of all Velocities should be very close to each other unless a major mistake has been made by the builder, or a major modification to the position, size, and incidence of the flying surfaces has been made due to error or by intentional experimentation. Small modifications to an aircraft can severely alter the flight characteristics, and the resulting aircraft can have a completely new forward and aft CG limit. Therefore, you could be flying within the limits of the CG box for a standard Velocity, but flying out of the CG box for your own aircraft. Small errors will have little effect, but if your wings or canard are an inch out of place, the situation will have to be taken into account. So if you built your aircraft with everything where it is supposed to be, you can use the standard CG box established by the factory.

If you add accessories to your airframe in the future, the proper procedure is to weigh the accessory, determine its ARM in the aircraft (distance aft from the datum line, which is the nose), and enter the accessory's moment into the total moment of the aircraft. Add the weight of the accessory to the weight of the aircraft, then divide the new total moment by the new total weight.

Pre-first Flight Systems Checkout

Before initial taxi testing is begun, each new aircraft should have a very complete inspection and functional test of its flight systems. Factory built aircraft are given a similar series of tests before the pilot ever sees his new mount; however, the Velocity owner must perform these production test himself. The following procedure should be used for initial system checkout and for each annual inspection.

General

- Check all fasteners for proper security and safetying
- Check canard attachment bolts for security and proper installation
- Check wing attachment through bolts, and nuts for installation and security
- Check wing incidence, canard incidence, rudder, ailerons and elevator deflections

Canard Incidence ±0.3°	=	(Use canard incidence template B&C)
Wing incidence Zero ± 0.5°	=	Wings must be within 0.3° incidence of each other. (Use wing incidence templates)

Rudder Travel 1.5" to 1.75" = Measured at the top of the rudder at trailing edge. Measure this with pilot holding full rudder pedal while someone applies a 5 lb. force inboard on the rudder trailing edge, to take any slack out of the system.

Elevator Travel	26° ± 2° Trailing edge down
	23° ± 2° Trailing edge up

Ailerons must both be slightly below the trailing edge of the wing 1/8" to 1/4" when neutral. At full deflection aileron T.E. must travel 2.5" ± 0.3" at inboard end (measure relative to wing T.E.).

Control System

- Check that canopy seals are in place and that canopy locking handle is adjusted so it must be forced hard forward to lock. This is extremely important to eliminate any possibility of it being bumped open in flight.
- Elevator and aileron push rods for proper installation (spacers, washers, bolts, locknuts, clevis pins, and safety clips, installed properly).
- Elevator and ailerons push rods for freedom of movement throughout control travel.
- Pitch, roll and yaw trim mechanisms for proper function, and freedom of movement.
- Elevator and aileron hinge attachment screws for security and nut installation.
- Elevator and aileron for freedom of movement throughout range without binding or chafing.
- Rudder pedals for freedom of movement, cable attachment and positive return to neutral.
- Rudder pulleys for free rotation and cable guard installation (the four cotter pins on the pulley brackets).
- Cable clearance throughout control travel.
- Brake actuating freedom.
- All rodends - reject any with evidence of bent tangs.
- Elevators for proper mass balance - nose down. Weight evenly distributed between inboard and outboard locations.

- Ailerons for proper mass balance - level to 10° nose down
- Check for 1/16" minimum clearances around all mass balances. Binding can occur at elevated load factors if clearance is too small.

Landing Gear

MAIN GEAR:

- Double check that all attach bolts and axle bolts are installed and secured.
- Check tires for proper inflation pressure (45 psi, wait 24 hours and see if they leak).
- Adjust brakes and test for proper function. Service with fluid as required. Bleed by flowing from drain up to master cylinder. Recheck rudder travel 1.5" to 1.75".
- Double check for proper main tire toe-in (1/4 to 1/2 degree per side)
- Wheel bearing packed with grease and safetied
- Brake mechanism for safetying

NOSE GEAR:

- Nose gear tire inflation, 45 psi
- Axle nut for security and proper installation
- Shimmy damper for friction adjustment (10-12 lb. side force at axle is required to rotate pivot)

Instrumentation

- Cylinder head temp, Oil temp, Exhaust gas temp - it is important these gauges be accurately calibrated prior to use. This can be accomplished using hot oil and a high-temp candy thermometer.
- Pitot/static systems - leak check
- Oil Pressure, Tachometer, Fuel Pressure - Function check on initial engine run

Powerplant

Check:

- Clock the prop for compression at the 10 o'clock position for proper hand-propping
- Propeller bolts for proper torque (30 to 45 ft lbs - refer to prop mfg recommendations) and safetying
- Propeller track and cracks
- Spinner track and cracks
- Engine mount bolts for security and safety
- Oil level
- Mixture, throttle, carb heat controls for security and proper function
- Magneto wiring. Be sure the mags are cold when the switches are off.
- Check that the magneto impulse coupling clicks at, or after, top dead center.
- Cowling baffles must fit tight all around the engine and cowl. If not, overheating will result.

Fuel System

- Check that the fuel caps seal securely and the vent system is clear without leaks.
- Calibrate your fuel gauges with the aircraft level.

CAUTION: Under no circumstances should fuel of a lower octane rating than that specified by the manufacturer for your engine be used. Be sure the minimum octane is clearly labeled by each fuel cap. Color coding for 80/87 is red, 100LL is blue and 100/130 is green. Auto gas, especially the high aromatic content no-lead, should NEVER be used.

Weight and Balance

Your final weighing before initial flight tests is very important and should be done carefully. The measurements taken should be recorded in the airframe log book and used in the weight and balance data kept aboard the airplane (see weight & balance section).

When loading the aircraft for the initial flight testing and for initial pilot checkouts, it is important that the weight and CG fall in the first flight box (see weight and balance section).

Note

A maximum gross weight, for takeoff of +5% may be used, but only under the following limitations:

1. Taxi and takeoff only on smooth hard surface
2. Maximum landing weight limited to 2250 (2400 for 173 model)
3. Maneuvers limited to normal category +3.8, -1g. No abrupt maneuvers.
4. Lift off at 75 knots and climb at 95 knots.
5. Before conducting over-gross operation, the pilot should be a proficient/competent Velocity pilot with at least 50 landings in the aircraft. The pilot should not attempt high gross operations at high density altitudes or gusty crosswinds. Max crosswind component is 12 knots.
6. High gross weight operations should not be considered a routine operation, since the chances of surviving an off-airport forced landing diminish rapidly as weight goes up. It should only be considered on those rare occasions when a long range, full fuel four place operation is desired. Routine operations above 2250 lbs. (2400 lbs for 173 model) gross weight are not recommended.

FAA Records

Records required for the Velocity are basically the same as for any production airplane (F.A.R. 91). A valid airworthiness certificate, issued by an FAA maintenance inspector, is required to be displayed in the cockpit, along with the aircraft registration certificate, weight and balance record and operating limitations. Radio equipped aircraft must also have a valid FCC radio telephone license. Airframe and engine log books are required as in any other aircraft. One area which is different from production aircraft is the method for maintaining records of major repairs and alterations. A major repair or alteration of the Velocity requires relicensing and issuance of a new airworthiness certificate and operating limitations instead of using FAA form 337A.

Equipment List

Velocity Serial No.	Reg #	Date
Paint Type	Color	No.
Trim Type	Color	No.
Interior Type	Color	No.
Engine Type		Reg #
Prop Make		Diam/Pitch
Status	Item	Weight
Arm	Moment	

Status of Equipment: X = Installed; O = Removed
Your equipment list should consist of all those items of equipment installed in the aircraft that determine the aircraft empty weight. This list should be complete to include as applicable: engine, prop, spinner, wheel pants, each instrument, radios, seat cushions, headset, intercom, battery, tie downs, canopy cleaner, lights, ballast, etc. Be very complete with this list and keep it up-to-date. Every item outside of basic air frame structure should be on this list. Use this list to correct and update the weight and balance. Weigh each item and determine the fuselage station for moment.

Initial Flight Testing

We highly recommend a complete factory check-out in our training aircraft. This is the best way to prepare you for your first flight. If this is not possible, use the following.

Now that you have completed your pre-first flight systems check, it is time to taxi and flight test your new Velocity. It is critical that you have completed 100% of the steps in the previous sections! As you complete the final checkout on your new airplane, you are going to be hot to fly your first flight. You may push a little too hard at the last minute and try to fly prematurely, possibly with something wrong with your airplane. To avoid this "homebuilder syndrome", give the only key to your bird to a close friend (preferably one who really likes you and to whom you owe money) and give the absolute authority to say "go" or "no go" to your initial flight tests. With all the other things you are thinking about, it is best to give the decision of whether the airplane is ready to someone else. If you really get a bad case of "homebuilder syndrome", your friendship may be strained somewhat, but you will be able to make up after you have tested your new bird safely.

The "homebuilder syndrome" has been a major factor in many first-flight accidents. Typical of this problem is where an individual spends all his time and money building his airplane, and, for several years, lets his flying proficiency lapse. Very typically we find a finished homebuilt with the owner/pilot seriously lacking in pilot proficiency. In one case, the pilot who tried to fly the first flight on his homebuilt had only one flight in the last two years! Another problem surfaces about the time the aircraft is ready to fly: "EGO" – that is, "I built the machine, I'll fly it. After all, who knows more about my machine than me...I built it." The homebuilder is understandably proud of his creation and becomes very possessive. So we find the proud builder/pilot at the end of the runway, "ready" for takeoff, with possibly a bad case of "homebuilder syndrome". But he will not know it until just after liftoff, when he finds himself suddenly thrust into an environment he is ill prepared to handle.

The best remedy for "homebuilder syndrome" is to accept help on your flight testing from an experienced Velocity or Long EZ pilot. Then get a good checkout from him after you meet the currency requirements.

Ground Testing

Do not just race out and fly your airplane first thing. You will spend a while checking out all of your systems on the ground before you leap off on the first flight. The first order of business is to check out your engine system thoroughly. Ground run it for an hour or so at low to medium power. Run it with the top cowling off and look for excessive vibration, unsafetied hardware, leaky fuel lines, or anything else unpleasant. After this initial run-in period (or the manufacturer's recommended run-in for new or overhauled engines), check everything over very carefully. Recheck the exhaust nuts for torque, look for leaks around gaskets, loose clamps, check fit of cowling baffles, etc. Check everything thoroughly before you button up the cowling to begin taxi tests. Be sure the engine compartment is clean. Check for nuts, washers, bits of safety wire, etc., because in a pusher everything that comes off goes right through the prop.

Low Speed Taxi

For fixed gear aircraft, make all initial taxi/runway flights WITHOUT wheel pants for better brake cooling.

Low speed taxi is defined as that slower than required to lift the nose wheel off the ground - 45 knots. Spend at least a full hour doing low speed taxi to fully familiarize yourself with the cockpit environment and to thoroughly check the engine, brakes, controls, landing gear, etc.

Thirty five knots is sufficient speed to evaluate rudder steering and brake effectiveness. You may find that EXTENSIVE TAXIING CAN OVERHEAT THE BRAKES. At 35 knots you will note that the sloppy feel of the control stick is gone and airloads now provide a comfortable centering feel.

Now is the time for the final FAA inspection and issuance of your airworthiness certificate. The necessary inspections by the FAA must be done prior to any flight testing! Be sure you have complied with all pertinent FAA regulations. Refer to FAA Advisory Circular AC # 20-27D for the details (Display of N-numbers, warning & ID plates, etc.) AC #20-27D is a must to have prior to calling for an FAA inspection. Be sure all the paper work is done!

High Speed Taxi and Nose Wheel Liftoffs

Before conducting the following tests with your new Velocity, do all of them first with two other different airplanes in which you are proficient. These maneuvers (nosewheel liftoffs at low power) are a little strange at the average pilot. Doing them in a familiar airplane takes the strangeness out of the maneuver and better prepares you to do them in a new airplane. It also gives you a first-hand look at runway length requirements and wind conditions.

Some of the following requirements and procedures may seem excessive. This is not due to any special feature of the Velocity; we feel they should be required of any homebuilt during their initial testing. The safety record of homebuilts during first flights is not as good as it could be if the owners and pilots would follow the following cautious procedures during initial testing.

- Weather - wind calm or smooth wind straight down the runway. Smooth air - check turbulence in another airplane.
- Runway - at least 3500 ft., preferably over 4000 ft
- Fuel - 10 gallon each side
- Pilot - see pilot experience requirements for absolute minimum criteria. Do not test fly a new airplane while fatigued: go home, get some dinner, sleep; you are more alert in the morning.

The reason for the long runway requirement is to allow you to do nosewheel lift-offs and decelerations without concern for stopping distance or BRAKE HEATING. The air must be smooth and without crosswind. Be sure you removed your wheel pants. Set the pitch trim for takeoff. Set neutral roll trim.

The purpose of this phase of testing is to evaluate the aircraft's performance and trim during high speed taxi/nose wheel liftoffs, to acquaint the pilot with the pitch and yaw characteristics of the Velocity, and, most importantly, to give him the correct visual cue of zero height to allow him to judge flare height on his first landing. The pilot should spend enough time just below rotation speed to be thoroughly proficient/ comfortable with the unique Velocity rudder system. There should be no tendency for the pilot to inadvertently push/deploy both rudders at the same time, unless during braking.

Next step is to practice speed control before attempting nose wheel lift offs. It is important to be able to control speed accurately so as not to get airborne inadvertently. You will find that once a speed is attained it takes VERY LITTLE power to maintain it. Practice accelerating to and maintaining different target speeds. (30, 40, 50, 60 knots) Do not rotate.

You will find that once the target speed is reached you must reduce power to idle or just a "hair" above to keep from exceeding it. Be proficient and comfortable in holding speed before moving onto nose wheel liftoffs. The aircraft will rotate at different speeds depending on gross weight and center of gravity. To determine rotation speed, accelerate to 50 knots, set power to maintain speed (close to idle), then attempt to rotate. If 50 knots is too slow to rotate, then go back to the start and try 55 knots, etc. Find the speed that will just rotate the nose (about 60 knots), reduce power to near idle and practice holding the nose at a predetermined position. Be careful to not over-rotate. Always keep the canard well below the horizon. The pilot should not allow the aircraft to exceed 65 knots or rotate to a point of becoming airborne during this exercise.

When you've done enough runs down the runway so that you can comfortably, smoothly and precisely control speed, pitch and yaw with the nose wheel off the ground, you should be ready for the first flight.

First Flight

You should be proficient in rudder operations and positive control of pitch control and are ready for the "big one". But be sure you review and understand the following.

The Velocity does not fly like a Cessna 150 or some other sluggish trainer. The Velocity is a high performance, responsive aircraft with differences. It has a side stick and the pilot should keep his forearm on the arm rest and use his wrist to control pitch. Also, the rudders can both be deployed simultaneously and the pilot should be careful not to inadvertently do this in flight.

There are two differences in a Velocity that must be thoroughly understood prior to flight:

1. The non-standard rudder pedals: Be sure not to inadvertently deploy both rudders at the same time in flight. If this happens, one will usually be out more than the other, producing unwanted yaw. The Velocity rudders are quite effective. Adjust the pedals so your foot does not press the pedals naturally.
2. Pitch over-controlling: The novice pilot will expect the Velocity to handle like the C-150, or whatever he last flew. The experienced pilot knows that J-3 Cubs and Bonanzas handle differently and will make the transition easily. Spend enough time on the runway just above rotation speed but below lift off speed and practice controlling pitch so you can put and hold the desired/selected pitch proficiently. Hold the forearm on the arm rest and control pitch with the wrist only. Do not over-rotate! The highest rotation you should see during this or the later flights is the canard up to, but never above, the horizon. Better yet, keep it always at least 2° below the horizon.

Remember the first flight of your aircraft is just one baby step up from the lift off that you've just completed and is just the bare beginning of your flight test program. First flight should again be made under ideal weather conditions. The weight and CG position should be within the limited envelope for "first flight box". First flight is not intended to demonstrate the capability of your aircraft or of the pilot and should be flown very conservatively. Leave the gear down and give yourself one less thing to worry about. Limit your airspeed to a range of from 80 knots to 130 knots. Stay over the airport and resist the urge to buzz your observers. During your climb out, set your pitch and roll trims to trim the airplane for hands-off flight. This will be a handy reminder of trim direction, if the airplane needs adjustment. You will notice a small roll trim change when you reduce the power. The airplane will require more right trim with power off. Limit your first flight to feeling out roll, pitch and yaw responses and checking engine operation, temperatures, pressures, etc. Make your approach at 80 knots. Have a fast touch down (75-80 knots), leaving full stall landings for later in the test program.

After this first flight make a thorough systems check, clean and flush the fuel filter, electric fuel pump screen, and carb screen. Also remove and clean out carb float bowl. Check float needle valve and seat for cleanliness on carburated engine.

Envelope Expansion

With first flight completed and any squawks resolved, you are ready to expand your flight envelope. Do not promptly charge out and test fly your aircraft at the extreme CG position and weights. Expand your envelope in small increments. Remember, you have to spend 40 hours in your test area, so put the time to good use and do a professional job of flight testing. Before expanding the weight and CG range shown for initial testing, spend a few hours and become thoroughly comfortable in your piloting tasks. When you feel at home in the airplane, begin your expansion of the weight, CG position, load factor and airspeed ranges. Don't feel obliged to expand into the full ranges shown in the plans and in this handbook. Expand your limitations slowly, and if you reach a point that you feel uncomfortable, stop. The ranges shown are those demonstrated by the designer. Feel free to restrict your airplane as you determine in your own testing; just don't exceed the design limits shown.

Do not assume that your aircraft will fly exactly the same as N81VA. Minor homebuilder construction tolerances can effect flying qualities and performance; for example, your aircraft may exhibit less or more stall margin. As with any aircraft, completely determine your stall characteristics at a safe altitude, then operate your aircraft accordingly.

After you complete the expansion of the CG envelope on your aircraft, you may want to change the placarded min. and max. pilot weights to those in which you are comfortable.

Some words of general caution - wear a parachute for your flight testing. Never leave a squawk unresolved; find and fix problems as you encounter them. Airplanes usually give a hint of impending trouble. The problem is we pilots do not always listen. If something changes: a slight roughness/vibration, new oil leak, trim change, new squeak, etc., look until you find it - don't rationalize it away. Have bunches of fun.

Flight - Flutter Envelope Expansion

The first time you exceed 130 knot (150 mph) it should be done wearing a parachute and at a height of at least 7000 ft AGL. You should expand the airspeed envelope in increments of not more than 5 knots. At each increment, access the damping of the controls as follows: kick a rudder pedal, and jab the stick left, right, forward and aft. After each input the controls should immediately return to trim and any structural motion should damp within one cycle. This will require at least 3 or 4 dives, climbing back to altitude between dives. Do not expand airspeed in the dive when below 7000 ft AGL. Use care to not overspeed the engine RPM. If you have just increased speed and find lower damping (i.e., the structure or controls shake more after the jab than at the 5-knot lower speed), do not continue to higher speeds. Recheck balance and weights of control surfaces. Solve any suspected cause of low damping before expanding airspeed. Expand speed to at least the red-line speed you desire to place on your aircraft, up to, but not exceeding 200 knots. Placard your airspeed indicator with your red line.

Flight Check Lists

Exterior Preflight Inspection

COCKPIT:

Mag Switches - Off

Master Switch - On; check battery condition and warning systems

Master Switch - Off

Mixture - Idle cutoff

Throttle - Idle

Flight Control Locks removed, pitot tube cover, vents clear, tie downs

Stick - free and unobstructed

Rudder Pedal Area - clear of loose items, ballast not required removed

Rudder Cable / Quick Disconnect - secure

Pitch Trim - check operation and cable connected

CANARD NOSE SECTION:

Elevator - condition, hinges, balance weights secure

Elevator - free

Static Ports - unobstructed

Pitot Tube - clear undamaged

RIGHT FUSELAGE/WING:

Canopy Hinge - undamaged

Fuel Quantity - visually check

Fuel Cap O-Ring - condition

Fuel Cap - secure check alignment marks

Fuel Tank Vents - clear

Fuel Tank Drain - check free of water/sediment

Fuel - proper color (red 80, blue 100LL, green 100/130)

Wing and Vertical Fin - condition

Rudder - free, cable/hinges secure

Rudder Return Sprin - secure, returns to neutral

Nav Light - secure

Aileron - free hinges, secure

AFT FUSELAGE - ENGINE:
Main Gear Strut - secure
Brakes - check for wear
Tires - check wear and inflation
Cooling/Engine Inlet - clear
Drain Valve - check for complete shut off
Cowling - check condition; all fasteners secure
Propeller - check for nicks, cracks, erosion
Spinner - check for cracks, screws secure
Exhaust Tubes - check for security
Engine Area - general condition, baffles, loose items
Oil Level - check, dip stick and door secure

LEFT WING FUSELAGE:
Same as right

NOSE GEAR / LANDING BRAKE:
Strut/Pivot - secure, undamaged
Wheel Friction Damper - adjusted
Tire - Check wear/inflation
Landing Brake - check for damage
Landing Brake - retract

ENGINE START / COLD:
Mixture rich/carb heat cold
Throttle - full forward
Master Switch - On
Auxiliary Fuel Pump On for 5 seconds /check pressure (4-8 psi) or (15 ± for fuel injected engine)
Auxiliary Fuel Pump - Off
Throttle - retard to just "cracked" position
Mag Switches - On (Lycoming left mag only for start)
(if) Electronic ignition w/ 1 mag, then Electronic ignition - off
Propeller - Clear (holler loud, wait for response, have outside

observer confirm area clear)
Engage Starter
Both mags on
(if) Electronic ignition w/ 1 mag, then Electronic ignition - on
Check oil pressure

ENGINE START / HOT:
Mixture rich/carb heat cold
Throttle - full forward
Master Switch - On
Auxiliary Fuel Pump On for 1 second / check pressure (4-8 psi) or (15 ± for fuel injected engine)
Auxiliary Fuel Pump - Off
Throttle - retard to just "cracked" position
Mixture to idle cut-off
Mag Switches - On (Lycoming left mag only for start)
(if) Electronic ignition w/ 1 mag, then Electronic ignition - off
Propeller - Clear (holler loud, wait for response, have outside observer confirm area clear)
Engage Starter
Advance mixture rapidly as the engine starts to full rich
Both mags on
(if) Electronic ignition w/ 1 mag, then Electronic ignition - on
Check oil pressure

ENGINE START: (HAND PROPPING)
Mixture rich/carb heat cold
Throttle - full forward
Master Switch - On
Auxiliary Fuel Pump - On to check pressure (4-8 psi) or (15 ± for fuel injected engine)
Auxiliary Fuel Pump - Off
Throttle - retard to just "cracked" position
Pull prop through 8 blades (mags both cold)

Mags On (Lycoming start left mag only)
(if) Electronic ignition w/ 1 mag, then Electronic ignition - off
Hand-prop engine
Both mags on
(if) Electronic ignition w/ 1 mag, then Electronic ignition - on
Check oil pressure

BEFORE TAXI:
Correct plane position - rudders adjusted, seat cushions to place head within 1" of canopy top
Seat Belts and Shoulder Harness - adjusted/locked
Radio/Avionics Lights - On, as required

BEFORE TAKEOFF:
Fuel Caps - locked, check alignment marks
Controls - free and correct
Trim - set for takeoff
Speed Brake - up
Circuit breakers - in
Gen/Alt - on
Lights - as required
Flight Instruments - set (alt, D.G., attitude indicator, clock)
Engine Run Up - (list specific engine limitations)

- Mags
- Oil Pressure
- Gen/Alt output
- Carb Heat
- Fuel Pressure

Mixture - set as required
Static RPM - 2400 min.
Auxiliary Fuel Pump - on
Mixture - full rich
Speed Brake - up
Door(s) - locked/ visually confirm proper latch

TAKE OFF:
Gear up below 120 kts (if equipped)
Boost Pump - off (above 1000 ft. AGL)
Lean Mixture - as required

DESCENT/LANDING:
Circuit Breakers - in
Boost Pump - On below 1000 ft. AGL
Gear Down below 120 kts (if)
Mixture - rich as required
Props (if) in full
Carb Heat - on as required
Speed Brake - down below 110 knots on final approach
Seat belts - all fastened

AFTER LANDING/SHUT DOWN:
Boost Pump - off
Carb Heat - off
Speed Brake - up (after fast taxi speed)
Lights - off as required (landing, nav, strobe, cockpit)
Electrical Equipment - off (radios, nav)
Mixture - idle cut off
Mags - off
Master Switch - off
Secure aircraft, door, controls, tie downs.

EMERGENCY:
- Aux fuel pump on
- Mixture rich
- Carb heat on
- Switch Mags
- Primer in & locked

Maintenance/Inspection

Composite Structure

The Velocity is painted with a white acrylic enamel. UV Barrier is used (primer) to protect the epoxy and foams from deterioration. Do not expose unprotected fiberglass to sunlight for extended periods. Unpainted areas should be retouched. The high surface durability and high safety margins designed into the Velocity make it highly resistant to damage or fatigue. If the structure is damaged, it will show up as a crack in the paint. The strain characteristics of the material are such that it cannot fail internally without first failing the paint layer. If damage is apparent due to a crack in the paint or wrinkle in the skin, remove the paint around the crack (by sanding) and inspect the glass structure. Do not use enamel or lacquer paint remover. If the glass structure is damaged, it will have a white appearing ridge or notch indicating torn (tension) or crushed (compression) fibers. If there is no glass damage, it will be smooth and transparent when sanded. If there is glass structure damage, repair as shown in Section I. Delaminations are rare, due to the proper design of joint (none have occurred on the prototype). If a delamination occurs (skin trailing edge joints, etc.), spread the joint, sand the surfaces dull, trowel in wet flox, clamp back together and let cure, or use the method in the construction manual.

Inspect suspected debonds (areas where skin has separated from the foam) by tapping a 25¢ coin across the surface. Debond will give a "dull thud" compared to the "sharp knock" of the adjacent good area. Debonds must be repaired by injecting epoxy in one side of the area and venting the air out the opposite side.

Plexiglass Canopy

Due to the uniform frame and lack of metal fasteners, the Velocity canopy is not as susceptible to cracks as the common aircraft plexiglass component. If a crack up to three inches does occur, stop drill it just outside the crack with a 1/8" drill. Cracks longer than three inches require replacement.

Schedules Maintenance/Inspections

In addition to the schedule listed below, follow the manufacturer's recommendations for inspection/maintenance on items such as the engine, accessories, wheels, brakes, batteries, etc.

Each 25 Hours:

- Inspect the prop and spinner for damage/cracks
- Prop bolts – check torque (wood prop 35 to 45 Ft Lb, but check mfg recommendations) and resafety. Check after initial run, at 10 hours and 25 hours thereafter.

CAUTION: Prop bolts - recheck torque before next flight when a transition is made from a wet climate (high humidity) to dry conditions. Wood shrinkage in dry environment can loosen prop bolts and result in-flight loss of the entire propeller.

Engine Cowl - remove and check baffling for cracks
Engine Oil Change - 50 hours for spin-on paper element filter
Engine Oil Screen - (back accessory section) clean first oil change and every other thereafter
Fuel Filters - remove and clean (gascolator, electric fuel pump carb finger strainer)
Carb Float Bowl - disassemble and check for contamination. Inspect float needle valve and seat. Look for a gummy substance, clean if necessary. Perform this inspection each 25 hours until 100 hours, then each annual/100 hours thereafter.

NOTE:
Any contaminates (foam - flox, dust/chips, etc.) left in the fuel system during construction could take 50 hours or more to be completely purged from the system. Check the filters often during the first 100 hours. If this happens, remove.

Exhaust System - check for cracks, leaks and security. Carefully check the four exhaust gaskets for leaks. Never reuse an exhaust gasket.

Air Filter - check and replace if necessary
Brake Fluid Level - check
Cables, push rods, fuel/oil lines and electrical wires - check for chaffing
Fuel System - pressure check (electric pump on) for leaks and correct pressure
Engine Run - check for leaks, mag drop, mags grounded, idle speed/mixture and idle mixture cut off.
Landing Gear Attach Fittings - check for security or damage
Fuel Vents - check open
Canopy - Check hinges for damage, locking mechanism for rig/snub
Tires and Brakes - remove wheel pants, check tire inflation (45-55 psi mains, 45 psi nose), check wear on brake pads. Adjust nose wheel friction damper as required.
Lights - nav, landing, strobe, cockpit - check operation

Annual or 100 Hours

Accomplish all the items listed in the 25 hour inspection guide, plus all items in the "annual inspection check list" which follows.

Review the Velocity newsletter and subsequent for any "Kit Plans Changes (KPCs) / airworthiness directives. Also any FAA ADs that would apply to certified components/accessories. Be sure all are complied with prior to returning to service.

Review the weight and balance/equipment list for currency. (Airplanes are like people – they get heavier with age). The aircraft should be reweighed at the first annual. You may be surprised. Update the weight and balance form. Reweigh every 3 years, or after any major modification.

Main Wheel Bearings - Repack
Air filter - replace (if installed)
Engine - reference to manufacturer's inspection manual; be sure to check mags, grounding/timing, clean and gap spark plugs (.018").

Reverse top to bottom. Check compression; if below 70/80, investigate. Ops check engine controls, throttle, mixture, carb, lube and check for freedom of operation.
Control System - Inspect and lube all hinges, rodends, jam nuts, bearings; check for binding.
Canard - remove the canard and inspect rudder pedals, battery, nose gear retraction mechanism, canard lift tabs for damage/elongation, elevator torque tubes for damage, elevator balance weights for security/binding.
Pitot Static System - check for leaks.
Canopy Locking Hooks - check rig and proper snub. The handle must be adjusted so it has to be firmly pushed forward to engage the lock.
Wings - remove both wings (1st annual only, thereafter optional) and inspect the glass areas around the center section spar and wing attach fittings. Look for cracks, delaminations, etc. Note that the reason for this inspection is not based on any anticipated problem or failures, but to insure that the aircraft, at least once each year, is given a thorough structural inspection. It should not be necessary to remove the wings for subsequent annual inspections. All attach bolts, however, should be checked for proper tightness and a "coin tapping" performed to check for any delamination.

Inspect the entire surface of the aircraft. Look for evidence of cracking/delamination or deformity of any kind.

Canard Removal/Installation

The canard can be removed in about 15 minutes with two people. Tools required are one socket wrench (with 9/16 socket, 7/16 socket, 3/8 socket), a 9/16" box wrench and a 1/4" box wrench. Remove the nose access cover; disconnect any antenna and unhook the pitch trim spring. Reaching in through the nose access hole forward of the canard, remove the two AN-6 main canard hold down bolts. Remove the two 1/4" rear attach bolts.

With the canard removed, a through inspection of the trim springs, counterweights, and all pivot points between canard and elevator can be completed. Also a thorough inspection of all RG parts can be conducted along with any changes or repairs to the instruments/avionics.

Re-install the canard in the reverse manner as removal.

Maintenance/Inspection Check Lists

N#: SN: Date:

A. Propeller

1. Inspect spinner and backplate for cracks
2. Inspect blades for nicks or delamination
3. Inspect for oil leaks
4. Inspect prop mounting bolts for security. If safety wire is broken, recheck bolt torque.
5. Inspect hub for leaks and cracks
6. Check blades for looseness

B. Engine Group

1. Remove and inspect engine cowling for cracks
2. Inspect engine for oil leaks
3. Wash engine and cowling
4. Drain oil from sump
5. Inspect and clean the suction screen
6. Replace oil filter and inspect for contamination
7. Inspect oil temp sender unit for leaks and security
8. Inspect oil cooler for leaks and security
9. Service engine with proper quantity of oil
10. Inspect spark plugs for condition, clean and gap

11. Check cylinder compression

#1 /80 #2 /80 #3 /80 #4 /80

12. Inspect cylinders for broken and cracked fins
13. Inspect valve rocker covers for oil leaks
14. Inspect push tube seals for oil leaks
15. Inspect engine accessories for leaks and security
16. Inspect Ignition harness for condition
17. Inspect magneto points for gap and condition
18. Inspect magnetos for oil leaks
19. Lubricate breaker felt
20. Inspect distr. block and springs for cracks/security
21. Check magneto to engine timing
22. Inspect magneto switch and "P" leads for operation
23. Inspect air Induction system
24. Clean and inspect air filter
25. Inspect fuel injectors for leaks
26. Inspect fuel divider and lines for leaks and security
27. Inspect intake tubes/seals for leaks and condition
28. Inspect flexible fuel lines for condition
29. Inspect fuel control/injector for leaks and security
30. Inspect vent lines and engine breather tube for condition
31. Inspect fuel pump
32. Inspect vacuum pump for operation/security
33. Inspect exhaust stacks, connections and gaskets.
34. Inspect throttle, mixture, prop controls for travel and rigging
35. Lubricate engine controls
36. Inspect engine mount for cracks and security
37. Inspect engine mount bolts for condition and torque
38. Inspect engine baffles for cracks and security
39. Inspect engine mount cushions for condition
40. Inspect alternator and belt for condition and security
41. Inspect prop governor for leaks and security
42. Inspect starter for condition and security

43. Inspect starter brushes for wear
44. Inspect starter ring gear for wear and security
45. Safety removed components and reinstall engine cowling

C. Cabin Group

1. Inspect cabin door and windows for cracks and condition
2. Inspect upholstery for tears and condition
3. Inspect seat belts for tears, fraying and security
4. Inspect trim operation and indication
5. Inspect rudder pedals for operation and security
6. Inspect brake operation
7. Inspect brake master cylinder for leaks and condition
8. Service brake master cylinder as required
9. Inspect control stick and wiring for condition
10. Check nav lights, taxi, landing lights, and strobe lights for condition and operation
11. Inspect all panel instruments for condition and security and operation
12. Inspect pitot/static system plumbing for condition
13. Inspect, clean or replace vacuum filter
14. Inspect altimeter for security and calibration IAW FAR 91.170
15. Inspect fuel selector for leaks, condition and operation
16. Inspect fuel system drains for operation and contamination
17. Inspect cabin heater controls and ducting for condition and operation
18. Inspect cabin air vents
19. Inspect all radios and avionics for operation and condition
20. Inspect cabin door latches for operation and condition
21. Inspect wet compass for calibration card and security

D. Fuselage and Canard Group

1. Inspect battery for security
2. Service battery with water

3. Inspect electronic components in nose gear well for security and condition
4. Inspect hydraulic power pack for condition and security
5. Service hydraulic fluid as required
6. Inspect landing light and lens for operation
7. Inspect fuselage structure for cracks and condition
8. Inspect speed brake for condition, fit and operation
9. Inspect antennas, mounts for condition and security
10. Inspect canard for nicks, condition and security
11. Inspect elevator for condition and travel
12. Inspect and lubricate elevator hinges
13. Lubricate speed brake hinge
14. Inspect elevator control cables and rod ends for freedom
15. Inspect elevator tab for condition and rigging
16. Inspect all wiring for condition and safety
17. Inspect ELT for operation and security
18. Check ELT battery for expiration date

E. Wing Group

1. Inspect wing upper and lower surfaces for cracks and condition
2. Inspect wing leading edge fences for condition and security
3. Inspect fuel caps for condition and operation
4. Inspect fuel tanks for proper placards quantity/grade
5. Inspect winglets for cracks and condition
6. Inspect both rudders for condition, travel and security
7. Inspect rudder hinges and return springs, lubricate
8. Inspect rudder control horns for security
9. Check rudder operation
10. Inspect ailerons for condition, cracks and security
11. Inspect and lubricate aileron hinges
12. Inspect gear wells for condition, cleanliness, condition
13. Inspect aileron bellcranks, cables, and rod ends for condition; lubricate as needed

14. Inspect aileron torque tubes for condition
15. Inspect wing attach bolts for condition and security
16. Inspect wing for fuel leaks

F. Landing Gear Group

1. Inspect nose gear strut for condition; lubricate
2. Inspect nose wheel for cracks, cuts and condition
3. Inspect nose wheel caster for security
4. Place aircraft on jacks
5. Inspect main tires for wear, cuts and proper inflation
6. Clean, inspect and re-pack main wheel bearings
7. Inspect brake linings for condition and wear
8. Inspect brake rotor for pitting and wear
9. Inspect brake caliper for condition and leaks
10. Inspect main gear spring struts for condition and security and rigging
11. Inspect landing gear fairings for condition

G. Landing Gear Retraction Check

1. Perform gear retraction
2. Check wheel clearance in gear wells
3. Check gear door fit
4. Check operation of gear position lights
5. Check operation of warning horn
6. Perform operational check of emergency gear extension
7. Inspect hydraulic lines for leaks and condition
8. Inspect gear actuators for proper travel, leaks and security
9. Extend landing gear and check safe indications

H. Operational Checks

1. Check fuel pump and selector
2. Check fuel quantity indicators
3. Check oil pressure/temperature indication
4. Check alternator output

5. Check manifold pressure indication
6. Check alternate air operation
7. Check brake and parking brake operation
8. Check vacuum gauge operation
9. Check air driven gyros
10. Check cabin heater
11. Perform magneto drop (RPM variation)
12. Check throttle and mixture operation
13. Check operation of constant speed prop
14. Check engine idle speed
15. Check electronic equipment operation
16. Check operation of all lighting interior/exterior

I. General

1. After shut down check for oil/fuel leaks
2. Check aircraft documents
3. Check applicable Airworthiness Directives
4. Complete paperwork (proper log book entry should read:)

" I Certify that this aircraft has been inspected on (insert date) in accordance with the scope and detail of apendix D of Part 43 and found to be in a condition for safe operation."

The entry will include the aircraft total time-in-service, the name, signature, and certificate type and number of the person performing the inspection.

XXX


Velocity 173 RG Elite

NOTES