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1.1 - Overview

1.1.1 - Description

The Velocity Aircraft is a four place family style homebuilt that has high performance yet remains a safe, practical, and stable aircraft. It is uncomplicated to build, comfortable to fly, easy to maintain, and beautiful to see.

- The RG option was the first major modification to be offered and incorporates retractable landing gear into any Velocity kit. This offers increased cruise speed and enhanced aesthetics.

- The yoke option was the last major modification. This option was designed with the newer pilot in mind. The yoke is a more conventional setup that is actuated just like the control system found in many trainers.

1.1.2 - Getting Started

Do your homework. The Velocity kit has been designed to be buildable by builders with limited experience. Still, the better you do your homework, the easier the job will be and the better the finished product.

- Get Back issues of the Velocity Views.

- Join the Experimental Aircraft Association and a local chapter. The E.A.A. can be contacted at 1-800-843-3612.

- Join the Central States Association, an association for fans of Rutan type aircraft. You may contact them at:
  Terry Schubert  
  Central States Association  
  9283 Lindberg Boulevard  
  Olmsted Falls, Ohio 44138-2407

- Build your reference library - and read it. There are many excellent books available to the homebuilder. There are any number of excellent books to help you with for starters, we would recommend:
  * **AC 43.13-1B, 2B Acceptable Methods Techniques and Practices.**
  * Am **ateur Built Aircraft Reference Material**
  * This is the Aircraft Mechanics Bible. This is definitely a **must have book.**
  * **The Sportplane Builder, Firewall Forward, Sportplane Construction Techniques, and On Engines,** by Tony Bingelis.
  * **Custom Built Sport Aircraft Handbook,** an E.A.A. publication.
  * **The Aircraft Spruce and Specialty Company catalog.**
  * **Composite Construction for Homebuilt Aircraft,** Jack Lambie.
  * **Light Plane Maintenance,** Subscribe at:
    P.O. Box 420234  
    Palm Coast, Florida 32142  
    (800) 829-9085

- Start a construction log. When it comes time to fly your airplane, the better you have documented the construction process, the easier it will be to please the F.A.A.
  Be sure to include entries for:
  * Task (what you were doing)
  * Date
• Start and stop times
• Elapsed time

• Take photographs and/or video of your progress to further document. They will ease the review with the FAA and provide a personal record of your efforts. Make sure your in a few of the photos working to show you actually worked on the plane.

1.1.3 - Video Tapes

A series of video tapes are provided with each kit. They were made while building the Velocity from a kit like yours. The sketches and narratives were made at the same time so that you can view the tapes a step at a time before going into your shop and then use your manual with familiarity. Since there are changes made to the aircraft that do not get incorporated into the video, use the tapes for building technique only and refer to your manual and newsletters for dimensions.

1.1.4 - Contents of Manual

The Velocity Homebuilding Construction Manual includes sketches, and detailed narratives of how to build a complete Velocity aircraft. The manual attempts to describe the construction steps in the optimal sequence to follow for each assembly. Cure times, space requirements, and personal preferences may change this sequence. There are times when portions of one chapter cannot be completed until sections from another chapter have been completed. We have attempted to indicate these areas in the manual, but you should read ahead and be familiar with the area in which you are working. We have provided a Flow Chart which shows the order in which way we at the factory prefer to build the airplane. Use this as a reference.

Each construction step has a line to the left (like this paragraph) to check when that step has been completed.

Paragraphs with the check-box to the left ask the builder to verify a measurement, alignment, or structure. Follow the old carpenters’ advice to “Measure twice, cut once.”

In the upper left-hand corner of each even-numbered page in the construction manual, there is a diagonal line as shown to the left. When all the steps on this (and the previous odd-numbered page) are completed, cut off the corner. This will help you keep track of your progress.

Though the Velocity is designed to be buildable by a first-time aircraft builder, this manual does not attempt to teach basic building terms and techniques. There are also some skills, such as constructing the radio wiring harness, painting and flight testing, that a builder might best seek help to complete.

Drawings in the manual are to illustrate general shape, fit and construction of the airplane. Unless otherwise specified, drawings are not to scale.

Templates in the manual should be photocopied to use. Check the copies against the originals to make sure they do not change size during the copying. There are also a number of full size templates included with your kit.

1.1.5 - Getting Help While Building

• Review the video tapes.
• Review the entire Velocity Construction Manual and the appendix, as it is packed with helpful information not found in the rest of the manual.
• Repeat 1 and 2 above.
• Talk to fellow members of the E.A.A., particularly those with composite building experience.
• Get started with the project. Answers to questions become obvious common sense with hands on experience.

• Ask another person for their understanding of what is written or drawn.

• Replay your video for the part in question.

• Review the newsletters for clarifications.

• Contact us: Velocity, Inc.
  200 West Airport Drive
  Sebastian, FL 32958

  Builders line: (772) 589-0309
  Phone: (772) 589-0309
  Fax: (772) 589-1893
  E-Mail: Support@VelocityAircraft.com

1.1.6 - Modifications

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Any changes made by the builder in the construction of the Velocity may alter the integrity of the aircraft structurally, aerodynamically, or both. Such changes could result in an aircraft that is extremely dangerous to operate.

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1.2 Materials

1.2.1 - Epoxies

Aero-Poxy - This is a one - one mix Structural Adhesive. Used in the kit for bonding premade parts together and bonding in Metal parts. Structural Adhesive usually needs to be thickened with a filler like Cabosil.

EZ-Poxy - is used in all major lay-ups on foam and all lay-ups of glass to glass. EZ-Poxy hardener is mixed with DER 324 resin at a 44:100 ratio. For lay-ups on foam, a slurry of EZ-Poxy and micro balloons is used. Throughout the construction manual this mixture is referred to as Micro-Slurry. It is also used with milled fiber for structural fillets and structural bonding such as hinge pockets for the speed brake, doors, etc. This epoxy was known as Epolite (2180/2183/2184) and SafetyPoxy in past manuals.

VelociPoxy - these systems are used primarily in the finishing and filling, never for glass lay-ups. VelociPoxy hardener is mixed with DER 324 resin at a 1:2 ratio. For finish work, VelociPoxy is mixed with micro-balloon to create a smooth easy to sand filler that is flexible. This epoxy was known as AlphaPoxy in the past manuals.

The resin for both EZ-Poxy and VelociPoxy are the same, only the hardener is different. The Resin is clear in color and is known as DER 324.

You may see references in books and catalogs and videos to Safe-T-Poxy, or Hexcel Epolite they have been replaced by EZ-Poxy, and Genimid or AlphaPoxy has been replaced by VelociPoxy. You may substitute the West System or Resin Research epoxy for VelociPoxy if desired.

1.2.2 - Glass Cloth

E-glass - (Electrical) the standard of the industry, both for marine and general aviation use. It is used throughout the construction.

Fiberglass is usually named for the orientation of the strength fibers in it and the weight of the cloth.

Knytex 20 Ounce Triaxial - called TRIAX in the construction manual, is used throughout. TRIAX has strength fibers running in three directions with one of them being the Major Axis. The Major Axis is shown by a line on the cloth. The builder will use it for bulkhead reinforcement, the skin of the wings and canard, and fabrications of various hard points and energy absorbing pads.

Hexcel 7.2 Ounce Unidirectional - called UNI in the manual. UNI has strength fibers running in one direction. UNI is used at the factory in the molding of the outer fuselage skin. It is used by the builder in the winglets, winglet attachment, elevators and canard skin.

8.9 Ounce Bi-Directional - referred to as BID in the manual. BID has strength fibers that run in two directions. BID is a coarse woven cloth used by the builder throughout to attach mating parts as well as constructing wing, rudder, and aileron end ribs.

S-Glass - a structural fiber, strong in tension, used in the spar caps and gear legs at the factory.

Hexcel 17 Ounce Biaxial Cloth - used by Velocity in premolded parts only such as the fuselage outer skin and landing gear reinforcement for torsional loading.

Hexcel 12 Ounce Biaxial Cloth - used by Velocity in premolded parts only such as the inner fuselage and strake skins and other small parts like the spinner, wheel pants, sump tank, etc.
Knytex 17 Ounce Biaxial Cloth - used by Velocity for primary shear web construction in all spars to handle compression loading.

Knytex 12 Ounce Biaxial Cloth - used by Velocity in secondary shear web construction.

Certanteed 22 Ounce Woven Roving - used only by Velocity in the cowling reinforcement.

Carbon - used in the Elite models for fuselage stiffening and in the RG for main gear reinforcement. There are no Kevlar or hybrid fabrics used in the Velocity aircraft.

1.2.3 - Fillers

Glass Bubbles - These are microscopic glass bubbles that the builder adds to resin to form a slurry for filling voids, forming fillets under glass lay-ups, and joining foam to foam and glass to foam. Mixed with EZ-Poxy, the bubbles lighten the lay-up and provide resistance to delamination. It is used with all foam lay-ups. The EZ-Poxy slurry is called Micro-Slurry in the manual. A dryer and thicker form of Micro-Slurry is called Micro-Balloon.

Many people have been confused by statements to use EZ-Poxy Micro-Slurry to cover the blue polystyrene foam surfaces just prior to glassing, since we also state in the plans that EZ-Poxy will dissolve the blue foam, but the slurry mix will not harm the blue foam. The epoxy has been sufficiently diluted by the filler material so do not be apprehensive about using the EZ-Poxy slurry on the core surfaces.

Milled Fiber - finely chopped glass fiber that the builder adds to resin to form a slurry to fill voids at hard points, attach glass to metal, and other structural glass to glass construction. It is light green in color, and much denser than the glass bubbles. Milled fiber is used for installing hard points, structural fillets and fairings, etc. It has superior secondary adhesive qualities. Mix with EZ-Poxy for filling voids around structural glass to glass lay-ups for compatibility with the EZ-Poxy lay-ups. Use with Structural Adhesive to attach metal pieces. Resin and Milled Fiber slurry is called Micro-Glass in the manual.

Flox - Flocked cotton fiber which may be used as a structural filler interchangeably with the milled fiber described above. Flox is not as dense or heavy as milled fiber.

Cab-O-Sil - this is a thickening agent for resin or structural adhesive. We found that by adding Cab-O-Sil to VelociPoxy or EZ-Poxy, we formed a strong, solid, heavy, but nonporous filler. When mixed with VelociPoxy to a paste consistency, it is good for fixing chipped or damaged edges of cowlings, doors, etc.

We also found it to be very helpful in filling the porous surfaces left after the Micro-Balloon process has been sanded. Apply with a putty knife or squeegee to porous surfaces. A small amount of Cab-O-Sil may be added to Micro-Balloon to make the mixture stickier, so that it stays where up put it. This is especially helpful on vertical or upside down lay-ups.

Be careful to remove all excess Cab-O-Sil, because once it has cured, it is very difficult to sand. Following cure, sand with 120-180 grit paper, then prime with epoxy primer. You will find that all those annoying pin holes have disappeared.

1.2.4 - Glues

Hot Glue - useful for holding parts in place, faster and cleaner than Bondo. It holds foam very well.

Bondo - a fast hardening putty that can be bought at any auto supply or hardware store. It is used to hold parts in place while applying permanent glass lay-ups. Do not use on blue foam because it will dissolve the foam.
5 Minute Epoxy - this is supplied in the kit and is used for quick bonding to hold parts in position for permanent lay-ups. It will not dissolve the blue foam.

CA or Super Glue - the thick type, works well for holding parts in place.

1.2.5 - Foam

Blue Polystyrene - this blue foam is a premium grade of extruded, not expanded, foam. All the foam parts have been pre-cut by Velocity with a hot wire to form the airfoils in the wings, winglets, and elevators.

Blue P.V.C. know as Dyvinicel - used extensively in the factory in the molding process of the Velocity aircraft. The builder uses it in the fabrication of the rear bulkhead and strake baffles and bulkheads.

1.2.6 - Plywood

Marine Grade Plywood - The wood supplied with the Velocity kit is a superior grade 6 mil, 5 ply plywood. It is specially designed and manufactured for epoxy lamination in the marine industry. It is superior to aircraft birch when used with epoxy for lamination of wood to glass as used in the Velocity construction process.

1.2.7 - Hardware

Wherever possible, aircraft grade hardware is supplied with the Velocity kit. A few special purpose fasteners are provided.

1.2.8 - O.E.M. Equipment

Many components are obtained by Velocity from the Original Equipment Manufacturer to keep the overall kit price to a minimum. These include wheels, brakes, tires, tubes, actuators, cables, etc. and materials.

1.2.9 - Machined Parts

Velocity has a complete machine shop including welding facilities that provide specialty items such as machined gear castings, control systems parts and assemblies as well as weldments for engine mounting and exhaust.

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1.3 Construction Techniques

1.3.1 - Mixing Epoxy

Epoxy resin is mixed in a ratio that allows it to combine at a controlled rate to form strong solid substance we call “glass”.

It is very important that the correct proportions of resin and hardener are used, otherwise, the results will be a substance that never hardens or one that hardens too quickly. Either condition produces a bad product.

We recommend the purchase of an epoxy ratio pump. It will save time, money, and inadvertent error. A proper ratio pump is manufactured by Michael Engineering and can be purchased directly from Velocity or an aircraft supply house such as Aircraft Spruce or Wicks. The time savings alone over using a scale is worth the price of the pump.

If preferred, a balance beam scale may be constructed per Figure 1-1. This scale is designed to mix the EZ-Poxy resin and hardener in one container as opposed to the “wet cup” balance beams in use with other kits. The “wet cup” method works but is a nuisance to most builders.

Counterweights:  
AN8-50 ~ 140 grams  
AN8-22A ~ 70 grams  
Use ½" washers or other ½" bolts to vary mix amounts

Figure 1-1. One Container Epoxy Balance

The VelociPoxy or West System epoxies are mixed according to the directions on their containers, not with the balance. You may purchase dispensing pumps for each different type of epoxy for ease of use.

Make a varied selection of counterweights to facilitate convenient quantities of mix.

It is important to mix the epoxy using the following steps. Post them on the wall behind the balance beam. For calibrating it has been suggested to use pennies in the desired Ratio Example 43-100 to check the accuracy of your scale.

• Place the empty mixing cup on the balance beam
• Balance the scale with the frameweight. (Be sure the counterweight is removed)
• Put the appropriate counterweight on holder “L”.
• Pour epoxy into the mixing cup to balance the scale.
• Move the counterweight to holder “1.44L”
• Add hardener to mixing cup to balance the scale.

A couple of cautions: Putting too little hardener in the mix will prevent a complete cure, the lay-up will stay soft or sticky. Putting too much will make the mix cure prematurely, maybe right in the middle of your lay-up! Take care when adding the hardener. Be sure to stir the mixture well, and do not add fresh epoxy to an old batch of mixed epoxy.

At times when the ambient air temperature is around freezing, the cure time for the epoxies will increase from hours to into days. A small heat source applied to the area for a few hours will bring your cure times back to normal. You should not do any body contouring while the temperatures is low either, as a spreadable mixture will be far too heavy.

1.3.2 - Cutting Cloth

Keep a neat clean flat area for cutting your cloth. Scissor cut large and irregular shaped pieces. Cut narrow tapes with a razor.

All BID tapes are cut on a 45 degree bias, i.e.: 45 degrees with the edge of the cloth. It is a good idea to cut about twenty 2” and 3” tapes and keep them handy in a box.

![Figure 1-2 Cutting Bid](image)

When marking to cut on the 45 degree bias the widths specified in the manual are perpendicular to the cut lines, and are not measured along the edges of the cloth roll, i.e.: a 2” wide tape is almost a 2-7/8” distance along the cloth roll edge.

Stagger the overlaps on multiple lay-ups to avoid big bumps in one spot. If more than one piece has to be used for one layer of UNI, e.g. on the elevators, butt the ends, do not overlap. Stagger the butting positions on subsequent layers.

1.3.3 - Sanding

Always sand existing cured glass before another lay-up. If there are oils or other substances on the surface, wipe the surface down with acetone before sanding. Use coarse (36 / 40 grit) paper for your sanding, and power sanders are OK provided you only lightly sand with them. This provides a grip for the new glass and removes the shiny top layer of cured epoxy. There is no need to sand aggressively and cut into the fibers of the previous lay-up.

1.3.4 - Glassing Foam

Mix glass bubbles with EZ-Poxy, making Micro-Slurry, for glass cloth lay-ups on foam. Mix to a mayonnaise texture. Always spread a coating of Micro-Slurry onto the foam before gluing or glassing. A lighter lay-up and a more complete bond will result.

Mix Micro-Balloons with VelociPoxy for foam to foam gluing. Mix to a paste or whipped cream consistency for foam to existing glass. Do not put Micro-Slurry or Micro-Balloon between multiple cloth lay-ups and existing glass. The bond in this case would not be as strong.
1.3.5 - Using Hot Glue, Bondo or 5-Minute Epoxy

Bondo is handy for holding parts in place while applying glass lay-ups. Hot glue is a better choice for most jobs because you can glass right over it. Use in small “dobs”. Be aware that Bondo dissolves blue foam! Use small dobs of 5-Minute Epoxy to hold blue foam in place.

1.3.6 - Glassing Cloth

Wet out cloth with a brush and a squeegee. The brush works better if about half the bristles are cut off. Dab or “stipple” the epoxy into the cloth where it appears dry or has air underneath.

A shallow angle between the surface and the squeegee will force the epoxy into the fabric. A straight or more vertical angle will remove epoxy. You want just enough to wet the fabric completely, no dry spots, but no more because it adds weight.

On a flat surface a large flat trowel or flexible putty knife works well. On confined or curved areas, use a flexible plastic squeegee.

Small, multiple layers of glass cloth are pre-wet, one on top of another, on a flat, plastic covered, or glass surface for a more thorough but not too wet lay-up and ease of application. Scissor trim cloth within 1/4” of edges to prevent lifting due to the weight of the wetted cloth drooping over the edge. Knife trimming an edge in four to six hours (when the lay-up is rubber and does not want to pull off the bonding surface) is much easier than sawing, grinding, or sanding once cured.

1.3.7 - Filling

Filling is done with Micro-Balloon. Small dings and voids are filled with a dry (thick) mix.

Micro-Balloon slurry fills voids, pores, and roughness between a cloth lay-up and foam and provides for better adhesion to the foam.

Do not apply slurry between a cloth lay-up and smooth bare glass, the resulting bond between glass to glass is not as strong. Micro-Balloon is used to fill in (sanded) glass areas. Micro-balloons are mixed with VelociPoxy resin to a thick paste (like peanut butter). This is then spread and smoothed with a trowel, you will be amazed at how dry (i.e.: light) your micro can be and still be spread out.

As with squeegeeing epoxy, the trowel angle determines the thickness or quantity of filler. VelociPoxy filler is easily sanded, shaped, and will finish smooth enough for paint priming. This can be used to repair dings or irregularities in the foam before glassing. Let cure and sand prior to glass lay-up.

Micro-Glass or Flox/EZ-poxy fill is used in structural areas. Mix milled fiber or Flox with EZ-Poxy for structural lay-ups and with Structural Adhesive for hard points.
All composite edges are relieved by sanding away about an 1/8" wedge of foam from the internal skin surfaces and filled with Micro-Balloon just before applying BID tapes to cover these edges. See Figure 1-3. Be sure to remove foam cleanly to the inside of the glass skins.

### 1.3.8 - Attaching / Joining

**ALWAYS . . .**

- Cut cloth to size in advance.
- SAND glass join lines to a sufficient margin for lapping glass lay-ups, delamination WILL occur if you do not.
- SAND metal parts prior to glassing, delamination WILL occur if you do not.
- Lightly pre-wet glass areas to be glassed over.
- Use BID cut on a 45° bias only.
- All glass should be handled carefully to avoid kinking the fibers. Kinks destroy the strength of that portion of glass. TRIAX is particularly vulnerable to handling damage. Kinks can and must be pulled out as shown in the video but it is best to avoid them.
- Pre-coat foam with EZ-Poxy Micro-Slurry for glass to foam.
- Pre-wet multiple glass cloth pieces for small lay-ups or hard points on a flat surface covered with visqueen. Allow the lay-up to set slightly so that the epoxy is not runny. Brush a fresh coat of epoxy on the area slated for application, and transfer glass to lay-up point.
- Follow the lay-up schedule in the construction manual.

### 1.3.9 - Hardware

Hardware is packaged and labeled with standard identification numbers and all hardware parts are referred to by these numbers throughout the construction manual.

Use the hardware called out in the plans. Structural hardware in the Velocity is aircraft grade, Air Force - Navy (AN) or Military Standard (MS) specification type. **Do not** substitute standard hardware store fasteners for these. The strength and tolerances are not intended to be the same as AN hardware.

If the specified bolt is installed and appears to be too long or too short, double check the structures being fastened to confirm they are correct. Better yet, have someone else check. Bolts that are too long can interfere with other systems such as landing gear or control systems. Bolts that are too short may fail to provide sufficient grip.

Correct length, properly installed bolts should have none of the threaded portion in the fastened structure. Generally three threads should show past the nut after it has been tightened, up to three washers may be used to achieve this.

Whenever possible, bolts should be installed with the head up or forward. This positioning tends to prevent the bolt from slipping out if the nut is accidentally lost.

### 1.3.10 - Work Habits

To avoid building an allergic reaction to working with the chemicals involved with building a composite airplane, wear plastic gloves while working with the resin and a face mask while sanding, grinding, or cutting with a power tool.
Never wash epoxy off with acetone! It removes the protective oils from your skin and washes the poison right through your pores into your system. Fast Orange hand cleaner (available at most hardware stores) works great at removing curing resin from your hands and skin.

Allergic reactions may not occur immediately. There is a cumulative buildup that appears after varying exposure to the resins and inhalation of dust. Do not wait for it to happen. Once it does, it is usually a permanent allergy and you will not be able to finish your airplane. While it goes away with abstinence, it comes back almost immediately with exposure to the resin or dust.

The EZ-Poxy is supposed to be nontoxic. Some people are not affected by any of the resins. Almost no one has a problem with these composite materials if reasonable precautions are taken. There are people who have worked full time for years that have no problems because they have good self protective work habits.

- Work at learning to mix, apply, cut sand, and apply, keeping the materials on the tools and the airplane and away from your body, inside and out.
- Keep lay-up and wetting areas clean as you work, no drips, no runs, no errors. It also saves a lot of work later.

We want you to have an enjoyable experience. We want you to finish your airplane. We want you to spread the good word and get others to enjoy it as well. Take proper precautions!

### 1.3.11 - Patching Foam

To patch a void, break, or ding that is too large to fill with dry microspheres, cut out a cavity in the foam with straight and smooth sides. Then cut a block to fit snugly leaving it large enough to protrude from the cavity for trimming and contouring to the original surface.

### 1.3.12 - Use of a Level

Level with a carpenter’s level on top of a straight edge. Do all leveling with a level that has been marked “top” and “right” so that, in use, you always orient the level the same way. This avoids errors due to slight differences when the level is turned over or around.

Proper flight and performance require the fuselage to be carefully leveled for-and-aft and side-to-side, several times during construction. Directions for doing this are shown in the video.

We use simple bubble levels to build our airplanes at Velocity. If you decide to use super accurate digital or laser levels realize that you will not be able to get things to within 1/1000 of a degree. The molds for the Velocity were all hand built and are not done to this level of accuracy. Don’t worry, your airplane will still fly straight.

### 1.3.13 - Micro-Glass / Micro-Slurry

Clean off any excess Micro-Balloon from joints or surfaces while it is still wet. It is hard to do later and you may sand, grind, or chip away more than you want to.

### 1.3.14 - Peel Ply

Peel ply is a light weight, Dacron or polyester material (normally 2.7 oz. Dacron) which does not bond with epoxy. It is applied over the top layer of a lay-up and then removed after the epoxy has cured.

It can be used in lay-ups to texture a glass layer for bonding with a subsequent lamination. Using peel ply between laminations eliminates the need for as much sanding for glass-to-glass bonding. It also leaves smoother edges on your lay-ups. Peelply traps excess resin in a lay-up that is removed when the peel ply is removed. Remember, it does not remain in the structure.
Peel Ply can be purchased from Aircraft Spruce or other Fiberglass Distributors.

1.3.15 - Tapping

Tapping is the process of creating a female (internal) thread in a (usually metal) structure. Tapping is used in the construction of the Velocity to create attachments to various hard-points such as for seatbelts and to install fuel fittings.

- Drill specified size hole in piece to be tapped. Make sure to use a sharp, properly sized tap. Remember, taps, like bolts, are sized by diameter and thread pitch. For blind hole tapping, a bottoming tap is recommended. It will produce the greatest thread depth. You would need a same size plug or taper tap to start the thread.

- Lubricate tap and material with a tapping fluid such as LPS Tap-All. Use lubricating fluid freely.

- Turn tap into hole making sure that it is square to the metal surface being tapped. You will not be able to true up the tap after it has started to cut.

- Back tap out and clear chips frequently.

- Do not continue to apply pressure to the tap after it has bottomed out.

- Remove burrs on the tapped hole with a smooth file. Use a rag, not your fingers, to wipe away excess cutting oil and chips.

1.3.16 - Fluid Lines and Fittings

Brake, fuel, pitot / static, and RG hydraulic systems require the installation of fittings and, in some instances, bending metal tubing. Follow instructions that come with tools and practices described in publications. You might want to practice on a few pieces of scrap material before trying the real parts.

When cutting tubing, it is important to produce a square end, free of burrs. Tubing may be cut with a tube cutter. A tube cutter can be used with any soft metal tubing such as copper, aluminum, or aluminum alloy. A tubing cutter can be bought at any hardware store for a few dollars.

Remove any burrs from the cut using a file, knife or deburring tool. Use care to avoid reducing the wall thickness or fracturing the end of the tube, this can lead to fractured flares or defective flares which will not seal properly.

Some sort of tubing bender will be needed to avoid kinking tubing as it is being bent. There are several varieties ranging in price from a few dollars to a few hundred. For the amount of work and size of tubing involved in the Velocity, low cost spring tube benders are a good choice.

Some of the fittings that will go on the tubing will require the end of the tube to be flanged. Aviation standard flanges are 37 degrees. Do not use automotive flaring tools as they produce a 45 degree flare which is unacceptable and will fail during service.

1.3.17 - Countersinking

There are several places where screws or rivets require a countersunk hole in the structure that they are fastening. Countersinking in an aircraft differs from street variety in two ways.

First, the angle of the cut required for aviation fasteners is normally 100 degrees. Non-aviation countersinks can range from 60 to 120 degrees.

Second, it is far more important to control the depth of countersink cut. Carpentry countersinks are just a shaped drill bit. Aviation countersinks are an adjustable depth tool which holds the cutter and controls depth of cut.
The design of the tool assures consistent depth of cut and to limit the depth so that the attachment is not weakened by removal of too much material.

These Countersinks and Countersink cages can be bought through aircraft supply store like Wicks or Aircraft Spruce.
1.4-Quality Assurance

1.4.1 - Quality Control

An advantage of composite construction is the ease of quality assurance. Since the structure is all external, problems are often visible. Any wrinkles or cracks or distortions at any time should be inspected to assure that they do not represent a structural problem which would compromise safety.

☐ Check for resin lean areas. Resin lean areas will appear white and are fixed with additional epoxy applied to or injected into the area.

☐ Check for wrinkles in the fibers. Kinking in the fibers significantly compromises the strength of the structure. Kinks or bumps in a structural piece greater than 2” of chord are likely cause for rejecting the part. Span wise measurement of kinking is unnecessary because the first kink is the one that compromises the structure.

☐ Check for delaminations or bubbles. If caught before cure, stipple epoxy into the area with a brush (poke at the area), then cover the area with plastic wrap to prevent air from reentering the trouble spot. Weigh down the plastic wrap until the laminate is cured.

The best time to fix any problem in the laminate is before it cures. After cure, delaminations and bubbles can be detected by tapping the wing with a coin. Any flaws can be fixed by drilling a small hole and injecting epoxy to fill the void.

1.4.2-Mindset of a builder

There are a few practices that a builder can adopt in order to assure that they will complete the Velocity kit they start.

When you start your construction, do not think of building the whole airplane at once. Instead break it down into more manageable pieces. For instance complete building the wings first. Than the canard. Then do the control surfaces on the wings and canard. If you break down the airplane into smaller more manageable tasks rather than looking at it as one large task you will have a better chance of sticking with it through completion.

As you build read through a complete chapter before starting a task. Try to understand the "Complete Picture" before you start. For instance when you install the counterweight onto your canard. If you do not read the complete section you might not know that the counterweights could limit our elevator travel if not put in correctly. Try as best as you can to visualize why you are constructing a part a certain way. If you spend a little time to understand what the final outcome of a certain task should be it should keep you from making errors.

* * *
1.5 Tools

There are a few special tools required to build a Velocity. There are a number of tools that can make the job a lot easier and save time.

1.5.1 - Water Level

A water level is assembled by attaching an 8’ tape measure to any vertical surface with 0” being on the floor. Take approximately 30’ of 1/2” clear plastic tubing, attach one end permanently at the 8’ mark. Partially fill water colored with antifreeze or dye and use a spring clamp on the free end so water does not run out while moving about.

1.5.2 - Benches

Build a sturdy fuselage support bench approximately 7’ x 3’ x 18” high. This establishes a convenient working height. Construct four sawhorses that stand at a comfortable working height. Purchase a pair of 3’ wide interior doors and check them for flatness. These are used for tabletops on the sawhorses.

1.5.3 - Necessary Tools

It is assumed that the builder will already have a standard set of tools. This includes hammers, screw drivers (slotted and phillips), pliers, wrenches, sockets, knives, levels, hex wrenches, tape measures, carpenter squares, clamps, files, scissors, sanding blocks, etc...

- Drill bits: 12” long by 1/4”, #19 (#8 clearance), #21 (#10 tap), #30 (1/8” rivet), #40 (3/32” rivet), #11 (3/16”/#10 clearance), 1/4”, 3/8”
- Taps: 10-32, 1/4”-28. 1/4” and 3/8” N.P.T.
- Hole saws: 1”, 1-1/8”, 1-1/2”, 2-1/4”, 2-1/2”, 3-1/8”, 3-3/4”
- Pop rivet tool
- Hand tools: Including drill and saber saw. (Hacksaw blades will work).
- Cleco pliers and clecos.

1.5.4 - Nice To Have Tools

- Micheals Engineering Epoxy Ratio Pump - 100:44 ratio. This is borderline necessary. It will save somewhat on the amount of epoxy you use and considerably in time and tedium of using a balance to measure epoxy and hardener.
- Bench Grinder / Buffer
- Drill Press
- Band saw
- Cordless Drill
- Air Compressor (minimum 5 horsepower if used with pneumatic sanding tools)
- Spray Gun
- Air Driven Die Grinder and a Small Right Angle Grinder with Accessories
- Air Saw
- Dremel Tool with Fiberglass Cutting Discs
- Small Electric Vibrating Sanders (for Light Lay-Up Preparation Sanding Only).
- Reamers: 3/16” and 1/4”