Aircraft Assembly Training Manual

Including some of the most common Design and Construction Standards for Zenair Aircraft*

Revision 3.0
April 2020

This Aircraft Assembly Training Manual outlines some of the most-often used procedures and techniques employed when assembling airframe parts and/or components for Zenair's wide range of professionally engineered all-aluminum "CH" aircraft designs. Using the provided documentation and instructions, this manual also contains three training exercises that are designed to train and prepare technicians in the proper assembly of Zenair parts and components.

NOTE: This Assembly Training Manual is for TRAINING PURPOSES ONLY.
It is not to be used for the manufacturing of parts or for the assembly of aircraft.

***Always use and refer to the COMPLETE and approved Drawings and Construction Standards Manual (CS) when manufacturing the actual aircraft.**

Aircraft Types: All CH Models

How To Use This Aircraft Assembly Training Manual.

This Training Manual outlines and explains the most common technical standards to which Zenair's professionally engineered aircraft have been designed. The sample drawings/tasks provided are designed to simulate aircraft assembly methods, specifications, materials and tolerances identical to those found in the standard aircraft **technical drawings** and as further detailed in the Zenair **Design and Construction Standards Manual (DCS)**.

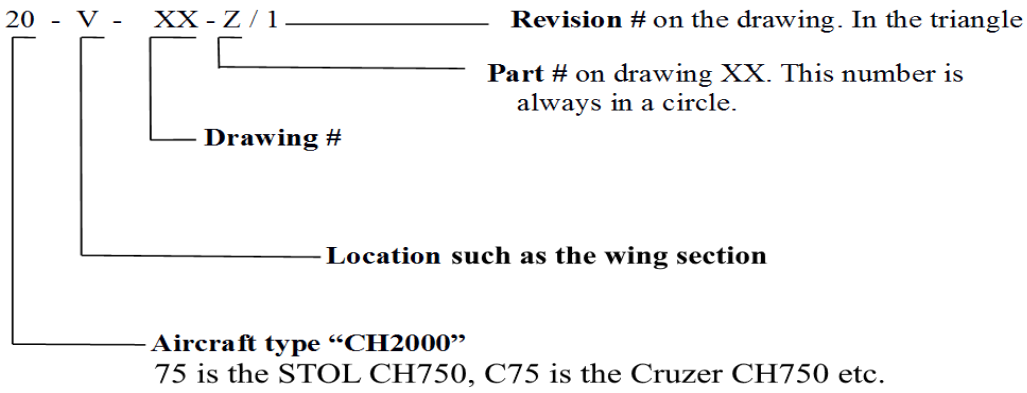
Before proceeding with the hands-on exercises, trainees should first read this manual from beginning to end; any familiarization with the other available and referenced documentation will be beneficial to trainees (see Section 17).

Section 13 of this Manual contains three hands-on **training exercises**. The instructions are to be used together with the corresponding "Training Kits" (parts) supplied by Zenair. It is strongly recommended that each trainee assemble and successfully complete each of the 3 assignments (this is a requirement for certification under Zenair's Technician Certification program). Contact Zenair for details and/or for assistance with evaluation of the assignments.

Table of Contents

SECTION 1: The Aircraft Drawings and Their Numbering System

In the bottom right-hand corner of every 11" x 17" page of drawings is a box containing a unique identifying alpha-numeric sequence. The numbers and letters in this sequence help identify the following:

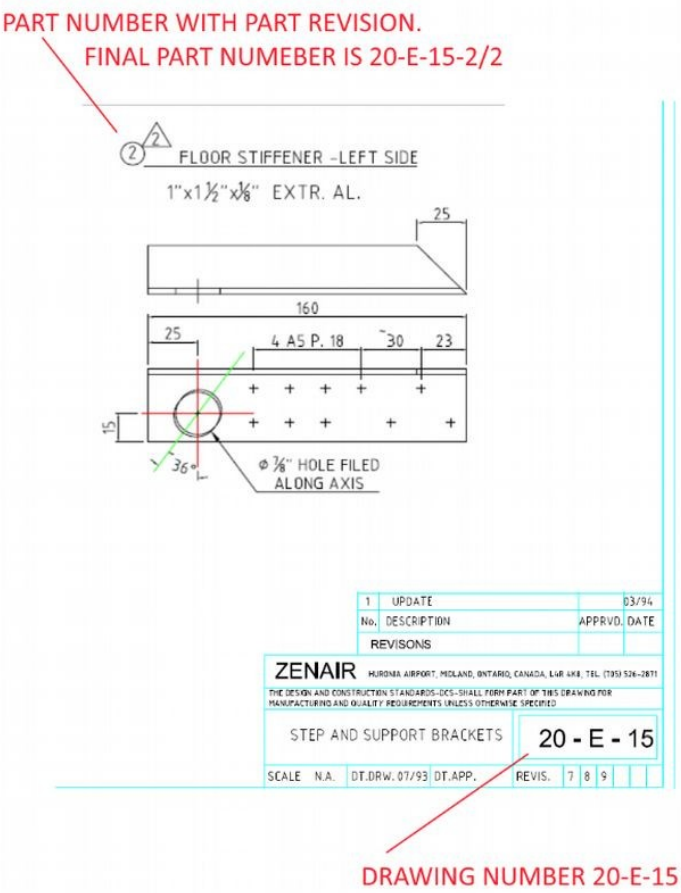


For Example:

Part number: 20 – E - 15 – 2/2

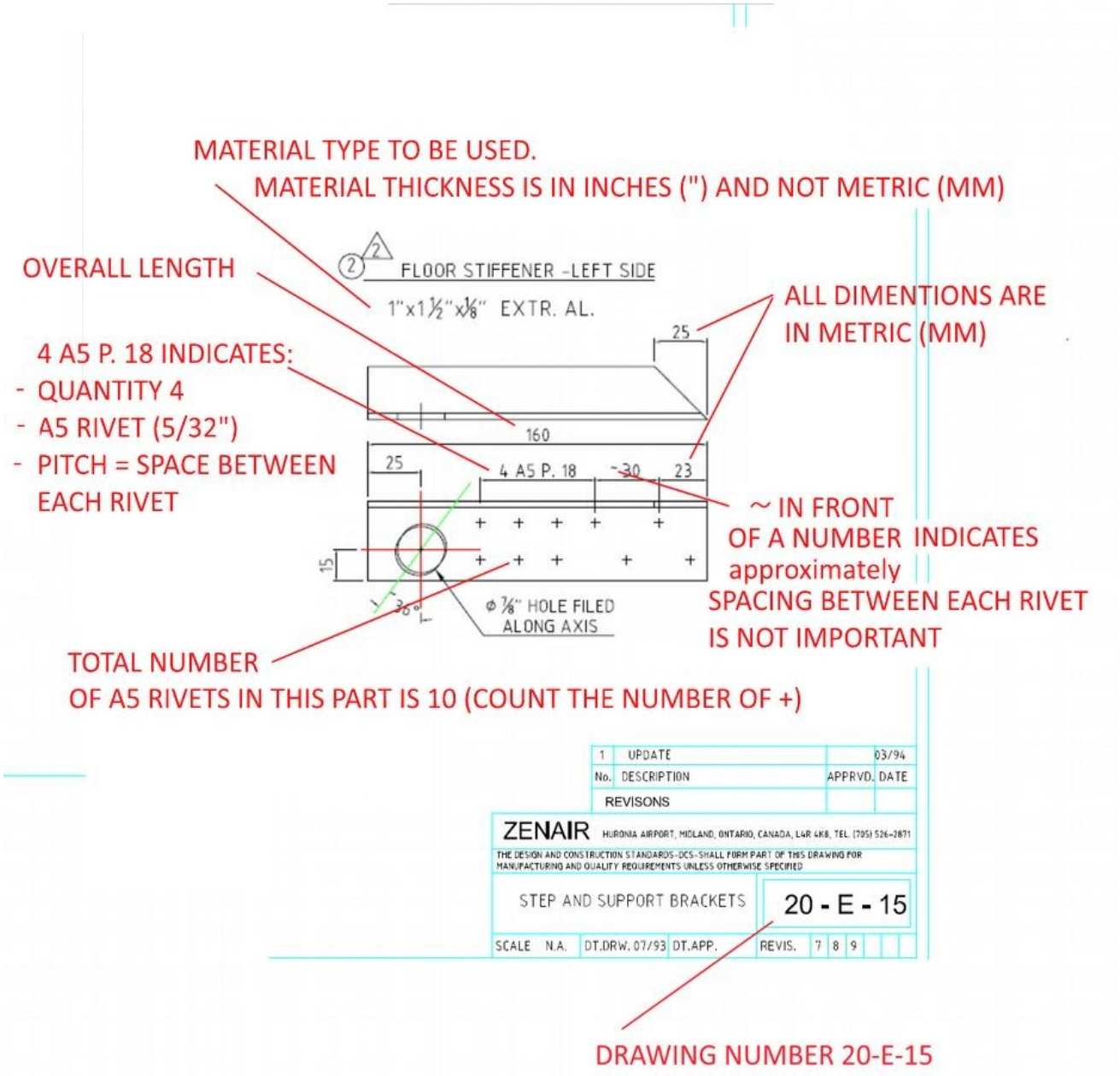
and

Drawing number: 20 – E – 15



How To Read And Understand The Drawings

The following diagram shows some of the more common information found in the drawings and how this information is usually presented:



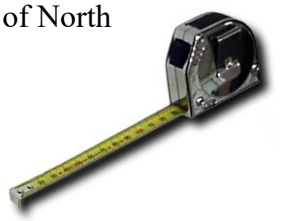
SECTION 2: Units of Measure and Sizes of Common Materials Used

1) The metric system

All manufacturing dimensions on the drawings are given in metric with the exception of standard North American materials and hardware, which are specified in inches (").

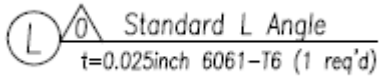
On the aircraft drawings, when a dimension is given and there is no indication of the unit of measure (no " or mm), it is assumed that the dimension is metric and in mm.

With material thicknesses such as 0.025", it is assumed that the material is of North American origin and the measurement is therefore given in inches (").



The following tables are conversion summaries.

2) Sheet metal and plate thickness



Mm	.4	.5	.6	.8	1.0	1.2	1.6	2.0	2.5
Inches	.016	.020	.025	.032	.040	.050	.063 1/16	.080	.090 .093

3) Holes Drilling

Mm	2.5	3.25	4.1	4.8	6.35	8.0	9.6
Inches	# 40	# 30	# 20	3/16	¼	5/16	3/8

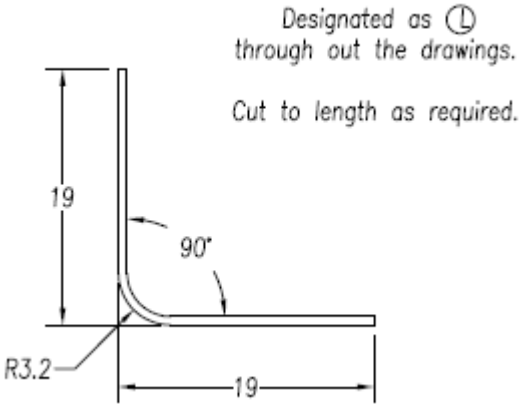
When reading the drawings, the following applies:

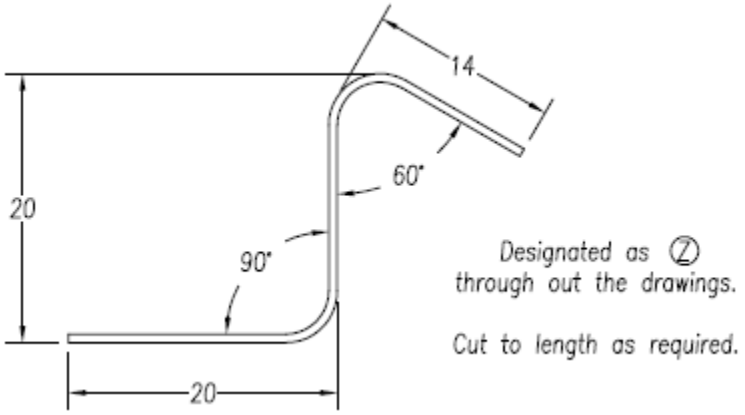
- Dimensions with a "~" are not critical. For assemblies, install to fit.
- Dimension in a box [...] are <u>critical</u> dimensions (typically used in the wing spars).

SECTION 3: Commonly-Used "Standard" Aluminum Shapes

BENT STIFFENERS "L" and "Z"

There are 2 types of common bent stiffeners in the aircraft. The drawings will specify them as **Standard L** or **Standard Z**. They are always the same type throughout the aircraft.





Note: While the material thickness of Standard Stiffeners is almost always .025", in a few instances and/or applications, the thickness will be different (usually thicker). Always check the drawings for the material thickness of the parts (indicated under each part number).

SECTION 4: Rivets

When assembling a Zenair all-aluminum airframe kit, the primary method of assembly will be "riveting". Two types of rivets are used: "Solid" rivets and "Blind" rivets. Most "solid" rivets are already factory-installed in a Zenair-supplied airframe kit; this leaves the "blind" rivets. There are literally thousands of blind rivets in a typical Zenair aircraft.

What to Know about the Blind Rivets used in Zenair Kits:

These rivets are custom-made specifically for Zenair and are slightly different than all other commercially available rivets. We call these "Zenair Blind Rivets".

1) These are aircraft-grade blind rivets (NOT found at regular hardware stores!). They are much stronger (in shear & tensile strength) than common hardware-store (i.e. "Pop" brand) rivets! For more information on rivet strength, refer to Page 25 in the CS manual.

2) Zenair rivets are made of 6061-T6 aluminum, the same corrosion-resistant aluminum alloy used in the aircraft ribs & skins. The chance of potential corrosion (between parts & rivets) due to electrolysis is further minimized when using identical materials in this manner.

3) The notch in a Zenair rivet stem (mandrel) is designed to "snap" lower in the rivet body than with other available rivets. This is so that the broken stem does not protrude from the rivet head, even when only two very thin parts are joined (riveted) together.

4) The head of a Zenair blind rivet is shaped very-much like a traditional "flush rivet" during its manufacturing process (even though it will have a "round" head when set in the aircraft). The round head is achieved during the rivet-setting process, by using a specially-modified "riveter-head" on the rivet-setting tool (see illustrations below).

   The use of this type of rivet-design and the unique related setting method (with modified riveter-head) was pioneered by Chris Heintz in the early 1970s. The system has been successfully used on thousands of aircraft, including type-certificated models. Zenair further developed this method when it introduced its own custom-made "Zenair Blind Rivets" – now delivered as standard fasteners with all kits for CH aircraft designs.

   Advantages to these rivets include:

   a) Made of 6061-T6 aluminum which is stronger and more corrosion-resistant than most commonly available "soft" aluminum rivets;
   b) Zenair rivets have a smaller head than other blind rivets that are manufactured as "round-head" blind rivets: smaller heads = lighter rivets & less parasitic drag…
   c) The rivet stem becomes "locked-in" after being set (won't vibrate loose);
   d) The "grip" lengths of Zenair rivets is among the best for blind rivets (greatest range);
   e) Zenair rivets provide a more "snug" (tighter) fit – when the edge of the rivet-head is pushed tightly against surrounding material during the setting process;
   f) Better price: Lower per-unit cost than almost any other aircraft-grade blind rivet!

"ZENAIR" BLIND RIVETS:

These blind rivets are available in several sizes and are set with a standard hand-riveter equipped with customized heads (nose piece). The setting process of these rivets is easy, fast and quiet. They can be set with access from only one side (no dolly or bucking bar is needed).

On the drawings, they are typically designated as **A4** (1/8-inch) and as **A5** (5/32-inch).

CODE	DESCRIPTION	DIAM.	DRILL
A4	Zenair aluminum rivet	3.0 mm (1/8)	# 30
A5	Zenair aluminum rivet	4.1 mm (5/32)	# 20
AS5	Zenair Stainless Steel rivet	4.1 mm (5/32)	# 20

A4 and A5 Zen
head-piece on t

Diagram at righ
(Two sizes are

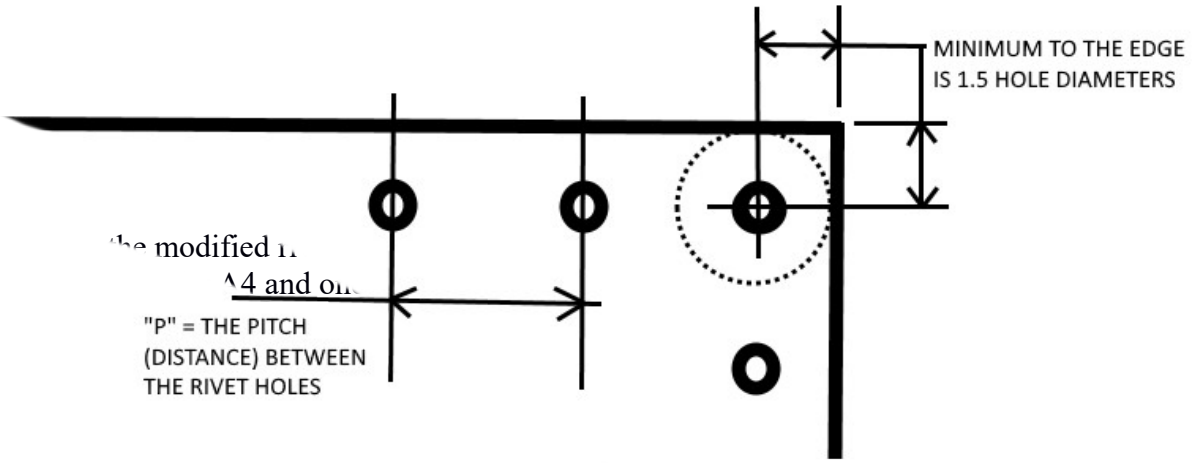
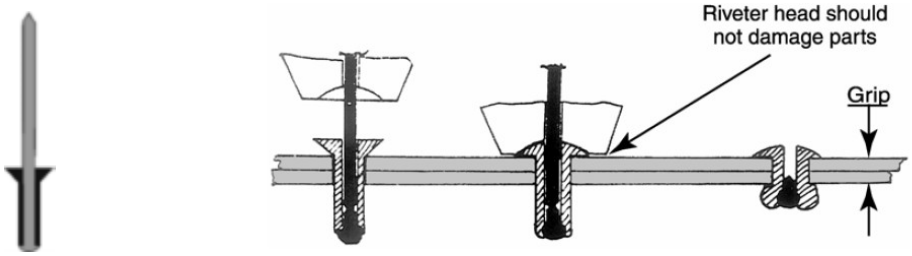


Diagram below shows an aluminum A4 or A5 rivet being squeezed:



A4 and A5 rivets have a low protruding ('lo-prc') round head formed with the special head.

Use the modified riveter head ONLY when installing the A4 or A5 Zenair rivets.

NOTE: When there is a choice, the rivet head should be placed on the side of the assembly with the thinnest material/part, or on the outside of the aircraft.

SECTION 5: Rivet Locations and Tolerances

1) PITCH

In the drawings, the distance required between each rivet hole is called the Pitch "P" and it is noted as P30 or P40, etc. The P states that the distance between the rivet holes must not be more than 30mm apart or 40 etc. Less is acceptable.

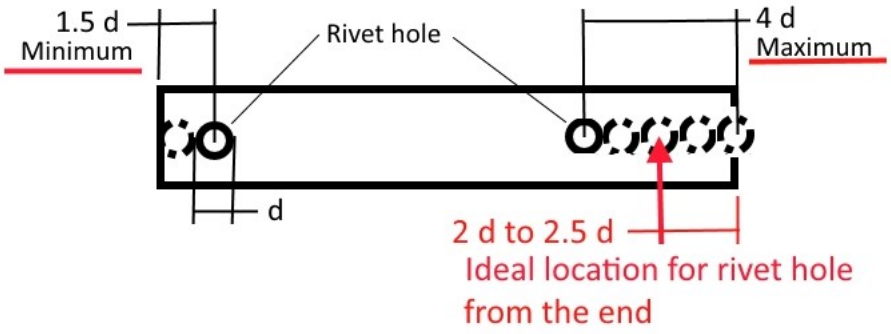
Unless otherwise specified on the drawings, following are the acceptable "P" tolerances:

2) DISTANCE OF HOLES FROM MATERIAL EDGE

- Unless otherwise specified in the drawings, all holes have a minimum distance from the edge of the material to the center of the hole. That minimum distance is 1.5d.

- Unless otherwise specified in the drawings, all holes have a maximum distance from the edge of the material to the center of the hole. 4d.

- When holes are close together, they cannot be closed than 2d from each other.



d = Hole diameter

3) WHEN INSTALLING "L" OR "Z" CHANNELS (STIFFENERS).

The drawings may not always specify the exact location of these channels (stiffeners) since they are always installed the same way – unless otherwise specified in the drawings.

Rivets are typically placed in the center of all channels.

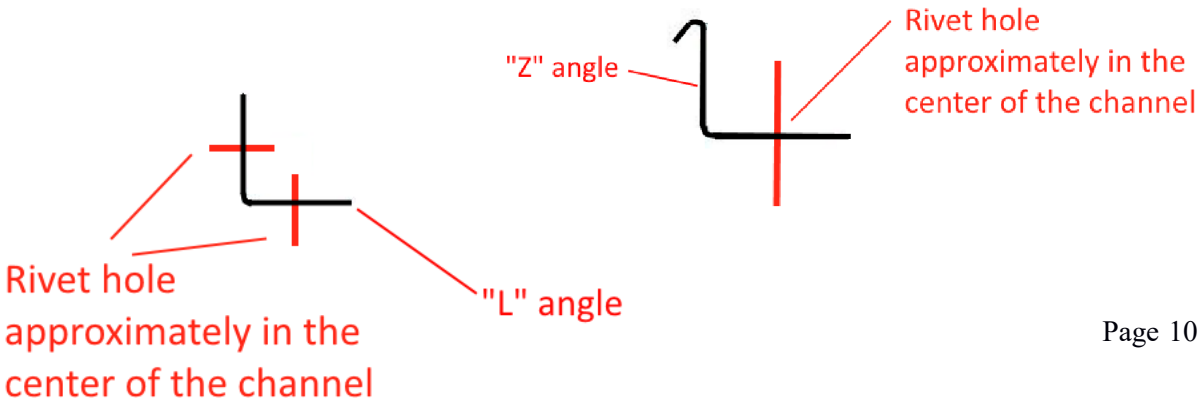
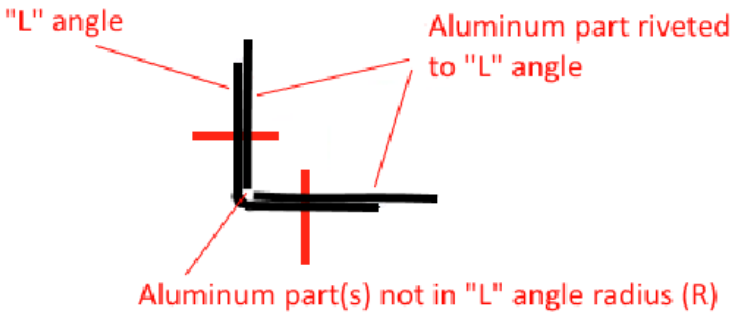


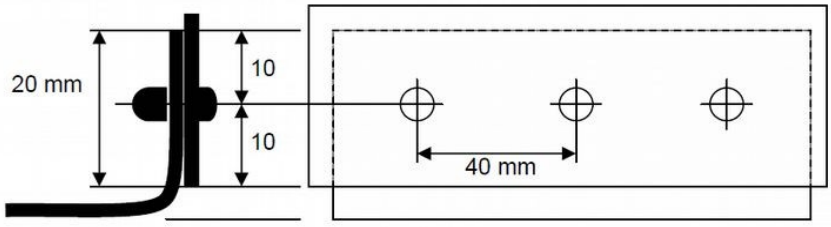
Diagram at left shows typical location of rivet holes when installing an “L” angle.

Shows aluminum parts installed to an “L” angle.

IMPORTANT: Parts must NOT be in the “L” angle radius.



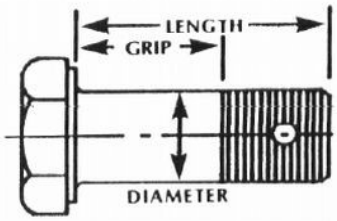
SHEET METAL JOINTS: The skins overlap on top of each other. The drawings show the suggested position and rivet pitch of the sheet joints



Rivet Spacing: 40 mm. = PITCH 40

SECTION 6: Bolts

AIRFRAME BOLTS – GENERAL



Bolt shown with drilled shank

AN Bolt designation: **AN – X – H – Y – A**

X = diameter: X/16 inch.

H = Dilled head (for safety wire)

Y = Length by increment of 1/8 inch

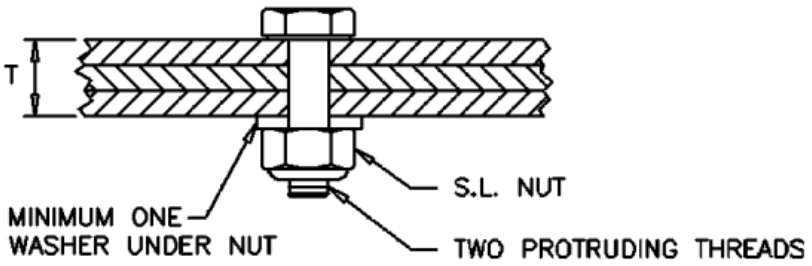
A = without any hole (if A is omitted: castle nut and pin).

Machine screws: AN525-10-32: same dia. and nuts as AN-3 bolt.
AN 525-8-32 Dia .102" (drill #20) with SL nut AN 365-8-32, Washer AN960-8

BOLT GRIP LENGTH: Refer to the table published in the Standard Aircraft Handbook. No thread in the parts, and two threads visible above the tightened SL nut.

- Minimum: no washer under the head.
  One washer under the nut.
- Maximum: one washer under the head
  Two washers under nut.

DRILL		BOLTS			NUTS		WASHERS	
INCH	mm	AN#	THREAD	DIAM.	CASTLE NUT	SELF LOCKING (SL)	AN#	THICK.
3/16	4.8	AN-3	10-32	.189"	AN 320-3	AN-365-3-10-32	AN960-10	.053"
1/4	6.4	AN-4	1/4 - 28	.249"	AN 320-4	AN-365-4-428	AN960-416	.063"
5/16	8.0	AN-5	5/16 - 24	.312"	AN 320-5	AN-365-5-524	AN960-516	.063"
3/8	9.6	AN-6	3/8 - 24	.374"	AN 320-6	AN-365-6-624	AN960-616	.063"



The bolt grip length, unless otherwise specified, must meet the following:

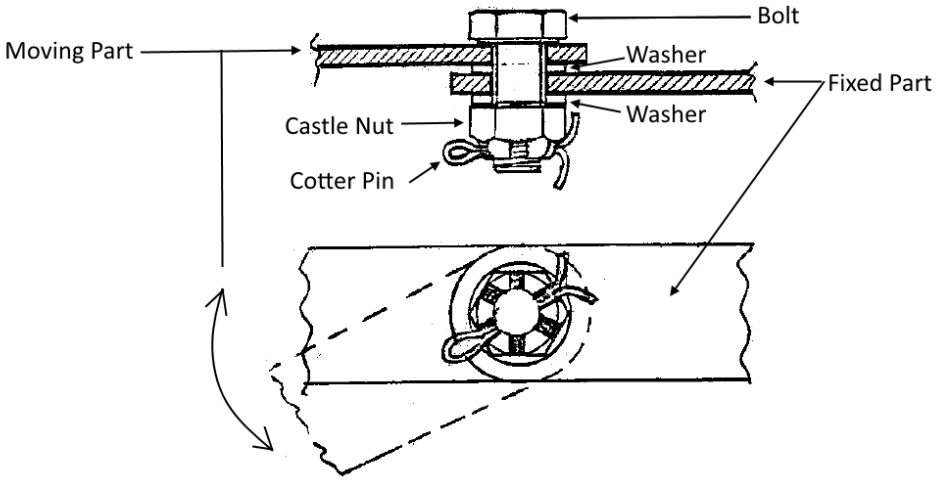
- No thread in the parts to be joined
- Minimum: One washer under the nut
- Maximum: One washer under the head
  Two washers under the nut
- Minimum: One and a half threads protruding over the locknut
- Maximum: Three threads protruding over the locknut

AN Bolt lengths come by increments of 1/8" = .125"
AN 960-x16 washers are 1/16" = .063" thick, (therefore, 2 washers = 1/8")

Bolt torque: Table for AN 365 nuts on AN-3 to -8 bolts, dry (not oiled) threads – refer to Chapter 7 section 3 of AC43.13-1B

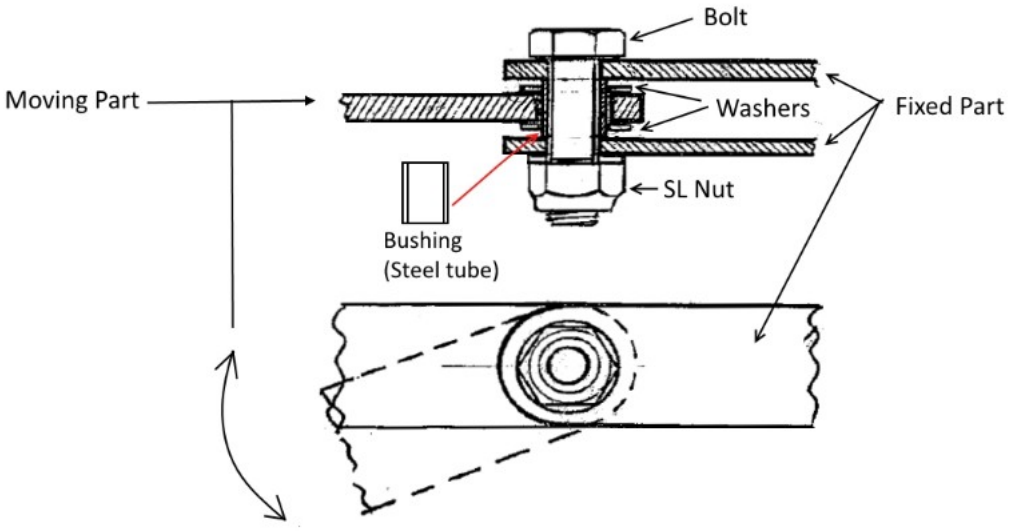
Moving parts and bolts:

Example A



The above bolt is rotating when the part moves. The shank can turn on its bearing surface. The moving part cannot be clamped tight. There must be a slight gap so that the moving part rotates freely.

Example B



The above bolt is tight on the bushing. The moving part rotates around the bushing. The bolt does not rotate. The moving parts cannot be clamped tight on the fixed part. There must be a slight gap so that the moving parts rotate freely.

SECTION 7: Aluminum Corrosion Protection On Assemblies

All matching parts may be corrosion-protected (recommended) on all matching surfaces.

Procedure:

- Degrease (with lacquer thinner or equivalent) if required – if oil or grease is on the part(s).

- Apply one coat (brush) of Zinc Chromate (Zn–Cr) Primer to MIL P 8585

Before using Zinc Chromate Primer, it should be diluted with Paint Thinner at a ratio of approximately 50%-50%.

STEEL PARTS CORROSION PROTECTION

All bare steel parts should be painted

- Degrease (lacquer thinner, or equivalent) – only of required –
- One coat of rustproof paint with Etching Primer

SECTION 8: Marking and Drilling the Parts

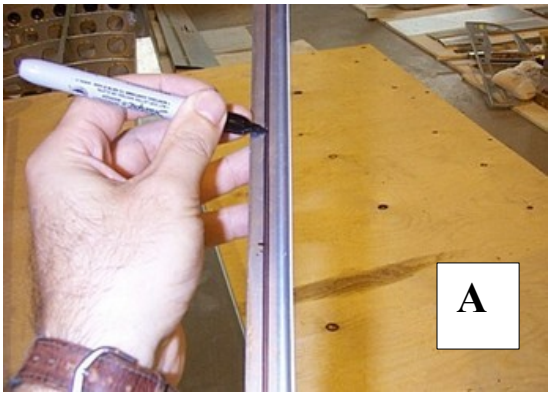
1) MARKING

Before drilling or positioning parts together, draw the position on the part(s) and mark the holes. Use a felt-tip marker to draw. Do not use a pencil or ball-point pen. Use a straight edge to mark straight lines. To draw lines along a rib flange, it is often easier to simply use your hand (finger) as a reference, or you can use a simple "marking" tool.

Lay out the rivet pitch (spacing between holes) shown on the drawings. The drawings provide either the rivet pitch, or the number of rivets.

Photo A (below left) shows how to draw a marker line on an “L” angle.

Photo B (below right) shows how to mark the rivet hole pitch “P” on the parts. Use a tape measure and marker.



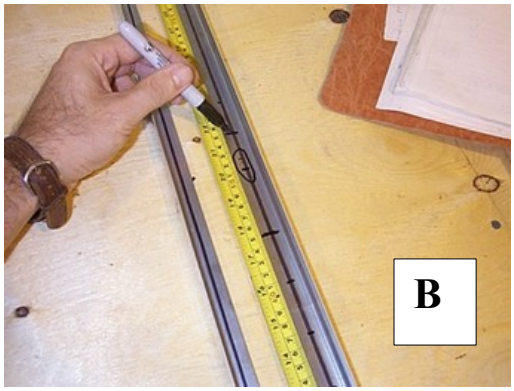
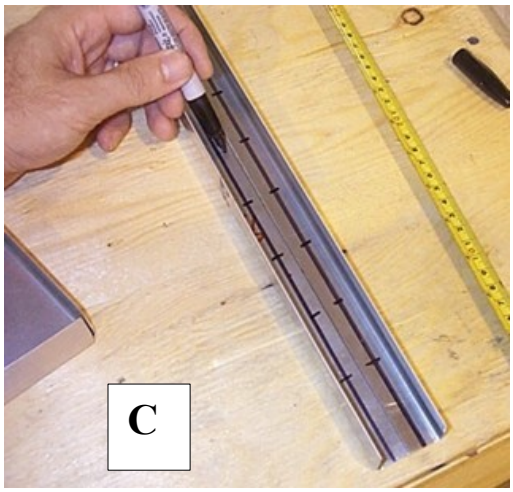


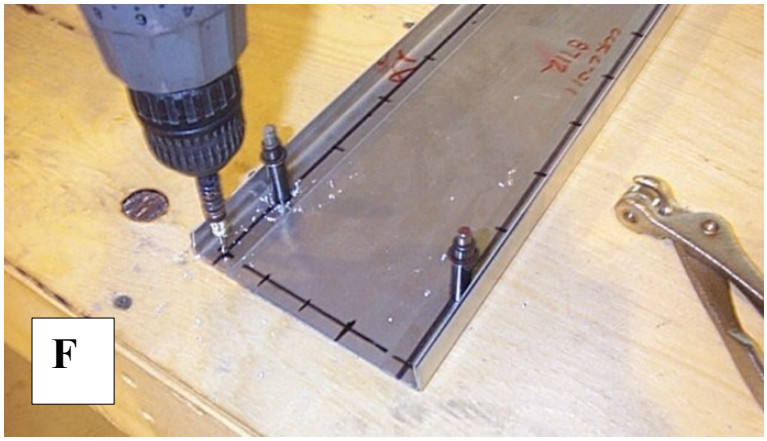
Photo C (right) shows an easy way to mark pitch “P” for the rivet holes on another part. You can lay the parts side-by-side and simply copy the marked pitch from the first part.



2) DRILLING:

Clamp the parts together and drill a hole. After drilling the first hole in the parts (D), cleco the parts together (E). Next, drill and add a cleco in every 3 to 5 holes. Then, drill all the holes in-between.

Photo below (F) shows the holes being drilled after the parts are clecoed together.



Helpful tip: You can Cleco and drill directly into the work-bench as shown in the photo (F)…

DRILL-BIT SIZE: It is important that the proper drill-bit size is used for each rivet size.

NUMBER DRILL BITS (HOLE DIAMETER)

	#30 (0.1285")	**#20** (0.1610")	**3/16"** (0.1875")	**1/4"**	**5/16"**	**3/8"**
mm	3.2	4.0	4.8	6.4	8.0	9.6
BLIND RIVETS (AVEX)	A4	A5				
BOLTS (AN)			AN-3	AN-4	AN-5	AN-6
SCREWS (AN-525)		8-32	(10-32)			
SOLID RIVETS (AN-470)	AD-4	AD-5	(AD-6)			

The blind rivets will fill-in holes that may be slightly over-sized as they expand when set. This is not the case with bolts. For bolts, use the correct drill-bit size as per table above.

SECTION 9: Drilling Out & Replacing Rivets

In some instances, it may be necessary to replace one or more rivet(s).

Reasons for this could include:

- Premature setting of the rivet(s) - (too early in the assembly sequence)
- An improperly set rivet (i.e. not fully engaged in hole prior to squeezing/setting)
- Incorrect rivet: Wrong-sized or wrong type of rivet
- Use of incorrect head on the riveter (causing a malformed rivet head)
- Loose rivet (can be caused by different factors)…

Blind Rivets:

Steps for drilling out and replacing a Zenair "blind" rivet:

As a first step, you will want to remove just the head of the rivet. This is done using a drill with the same size drill-bit as for the original hole (#30 for A4).

Step 2: Carefully drill off the rivet head (then remove it from drill-bit if necessary).

At this point, for Step 3, you can turn the drill by hand (or apply short power bursts on the trigger) to try and push/drill the remainder of the rivet out. Note: firmly support the drill during this process, hold it straight and in-line with the rivet and apply force as needed. This will often suffice to drill-out/push-out an unwanted rivet.

Caution: If the spinning drill-bit hits the harder steel nail (mandrel) inside the rivet during Step 3, it will want to go into the softer surrounding aluminum (rather than stay on the nail). If this starts to happen, stop the drilling immediately! Failure to stop will create an elongated (over-sized) hole at best, or it can destroy the part(s) at worse!

At this point, get a hammer and a center-punch or other thin rod (thinner than the hole size), and try to dislodge the rivet nail from the rivet. When the hammer hits the punch, the entire remaining rivet often pops out. If only the nail has dropped out, continue with the drill…

Once the hole is clear, check for any damage and make sure all parts are straight (sometimes the flange in the back can be bent out of the way by the drilling/punching process).

Finally, when ready, replace the rivet, as originally intended.

Solid Rivets:

If you need to drill-out a "solid" rivet, use the same first three steps from above.

SECTION 10: Common Tools & Recommended Use

Only very basic tools are needed to assemble a Zenair kit aircraft from the supplied kits. Following is an illustration and a listing of the basic required tools for assembling the aluminum parts.

If you do not yet have these tools, Zenair can supply a basic "starter tool kit" separately.

HTK - COMPLETE HAND-TOOL KITS FROM ZENAIR **Packing List 04-2018**

Note: Tool kits ordered through Zenair Ltd may differ slightly from tool kits provided by Zenith Aircraft Co.

PART NO.	DESCRIPTION	QTY	SHIPPED	Back-Ordered
60-310B	Air Drill - 4000 rpm (Optional)	1	[ ]	[ ]
P-RIV	Pneumatic Riveter with Custom Machined Heads	1	[ ]	[ ]
H-RIV	Hand Riveter with Custom Machined Heads	1	[ ]	[ ]
CLE-PLI	"Cleco" Pliers	1	[ ]	[ ]
TP176A	Toggle Clamps	4	[ ]	[ ]
42100	Finger "Handi-Clamps"	4	[ ]	[ ]
20-DB	#20 Drill Bits	10	[ ]	[ ]
30-DB	#30 Drill Bits	10	[ ]	[ ]
40-DB	#40 Drill Bits	2	[ ]	[ ]
SNIP	Left and Right sheet-metal snips	1 set	[ ]	[ ]
MTM	Metric tape measure	1	[ ]	[ ]
13801	"Sharpie" Extra-Fine felt tip marker	1	[ ]	[ ]
13001	"Sharpie" Fine felt tip marker	2	[ ]	[ ]
FILSET	Hand file set (includes flat, half-round & rat-tail files	1 set	[ ]	[ ]
12-00184	Adjustable ("accordion") hole spacer (10 holes)	1	[ ]	[ ]
D-BURR	Double-Blade Hand Deburring Tool	1	[ ]	[ ]

Add the following quantities of Clecoes, based on aircraft model being assembled:

750-HTK (STOL & CRUZER)

332-CLE	3/32 "Cleco" temporary fasteners (silver)	50	[ ]	[ ]
4-CLE	1/8 "Cleco" temporary fasteners (copper)	150	[ ]	[ ]
532-CLE	5/32 "Cleco" temporary fasteners (black)	150	[ ]	[ ]

801-HTK (801, 640 & SD models)

332-CLE	3/32 "Cleco" temporary fasteners (silver)	40	[ ]	[ ]
4-CLE	1/8 "Cleco" temporary fasteners (copper)	100	[ ]	[ ]
532-CLE	5/32 "Cleco" temporary fasteners (black)	300	[ ]	[ ]

Zenair Ltd. P.O. Box 235 Midland ON Canada, L4R 4K8 Tel: 705-526-2871 web: www.zenair.com

Other common tools will be needed throughout the assembly of the aircraft (screwdrivers, wrenches, files, hammers, etc.) however, the above sheet-metal tools will be used most often.

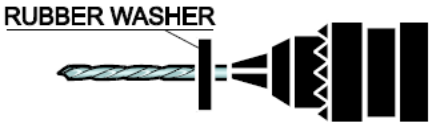
More On Two Common Tools Used To Assemble The Parts:

1) DRILL:

Electric Hand Drill: Standard plug-in or battery-Powered electric hand-drill or air (pneumatic) drill.

Suggestion: use a high speed drill (1,500+ RPM), which makes drilling quicker and easier. A variable speed drill is often easier to use.

DRILLING TIP: A simple rubber washer fitted on the drill bit shank can help prevent damage to the metal when drilling. Note: Self-made rubber washers can easily be made from pieces of old rubber fuel line…



Show rubber washer on a drill bit

2) HAND SNIPS:

Aviation snips: right = red handle, left = green handle. When using the hand snips remember that the cutting process is much easier (and neater) if you hold the snips at a slight angle (try it out on some scrap sheet metal). Avoid marking the sheet with the **snip tip** by only cutting on 1/2 to 3/4 of the length of the snip blade and not closing the snips completely. Most snips have serrated teeth along the edge of the cutting blade; depending on how new (sharp) they are, these "teeth" can cause the edge of the skin to be a little rough. After the final cut, clean up the edge by filling the edge smooth. When done, you should be able to run your finger over the edge without getting cut or picking up any slivers.

For more information on required tools, see here: http://zenithair.com/kit-data/tools.htm

SECTION 11: Edge Finishing

Sheet metal is typically cut with a shear, snips, saw, etc. and this cutting process will leave marks and/or sharp or rough edges.

As a general rule, **all primary structural tension members** (i.e. structure subjected to tensile stress in normal operation) should NOT show any cutting marks along their edges. This would include the wing spar caps, horizontal and vertical tail spar caps and fuselage longerons: On these parts, all cutting (manufacturing) marks along the edges of the material must be **removed** by lengthwise abrasion (body file, etc). Edges should be smooth!

Shear marks, (but NOT saw marks) are acceptable on **torsion and / or shear members and other secondary structural members.**

On **thick sheets and plates,** shear marks are acceptable when a 100% visual inspection does not detect cracks (ex. Control horns, etc).

On **all parts,** an acceptable way to remove a nick or crack is length-wise filing.

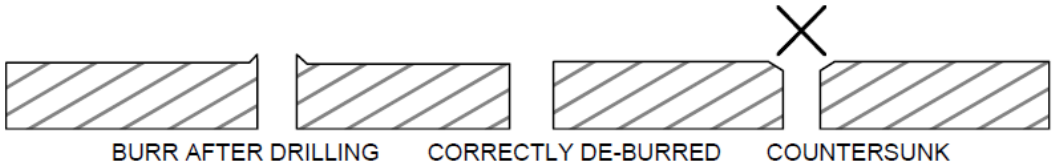
As a general rule, when you can feel a scratch by passing your fingernail over it, it is too deep. Sand or file down the scratch.

DEBURRING HOLES:

A "burr" is a sliver or sharp protruding piece of metal stuck on the edge of a hole. It is a by-product of the drilling process. It is important to remove ALL burrs prior to assembling parts to ensure that the parts will be properly/tightly joined when fastened together (with rivets or bolts). There are different ways to "deburr" (remove the burrs from the parts).

Using a **drill bit** to deburr thin material has tendency to "countersink" the hole (not desirable for our round-head rivets); on the other hand, deburring with the flat side of a **file** can scratch the material surrounding the hole. Use the most appropriate tool/method to obtain desired results.

In general a sheared edge does not have to be file smooth, it is unusual for a drilled hole to leave fracture marks around the hole. The purpose of deburring is to assure contact between the parts: to remove burs that have accumulated between the parts. Parts much be tight together when riveting.



A file was used for the correct deburring example in the above.

SECTION 12

AIRCRAFT ASSEMBLY TRAINING EXERCISES

Purpose: For participating technicians/mechanics to become familiar with the type of drawings and instructions provided by Zenair for assembling its airframe kits, and for them to satisfactorily complete three assembly exercises/tasks. Primary objectives are **Accuracy** and **Quality** of workmanship. Note: The complexity and level of difficulty will increase with each of the three exercises.

Tools needed:

How to proceed:

1) Prepare your work area (flat, wood-covered work table).
2) Make sure that you have all the necessary tools at your disposal (see above).
3) Have a copy of the one-page drawing for assignment to be completed (samples below).
4) Have the box of unfinished parts and hardware received from Zenair handy.

5) Use the "Materials List" from the drawing to select the needed parts (inventory).
6) Measure, cut, trim and file-down each of the unfinished parts as needed.
7) Mark, position and drill the parts as indicated (refer to this manual for details).
8) Assemble as per drawings and write your name & the date on it.

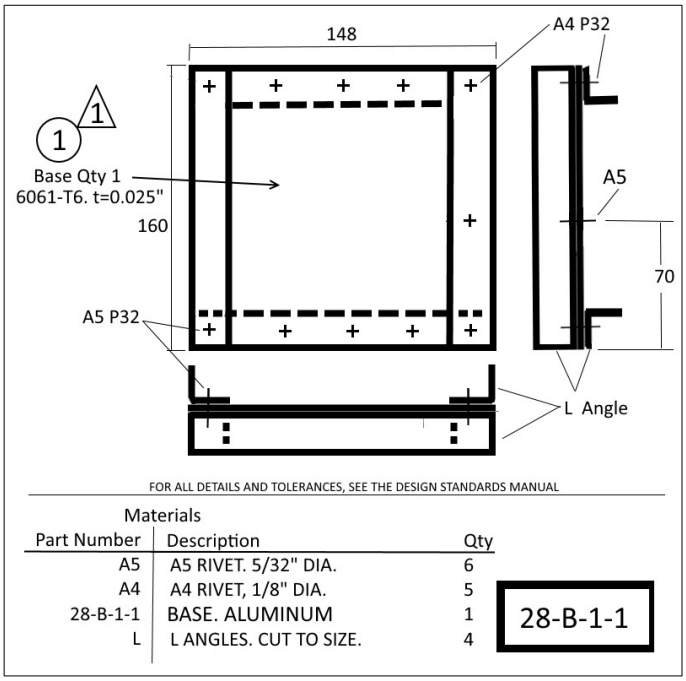
When finished:

Clean-up and send pictures of the assembly (viewed from all sides) to Zenair for evaluation & comments. Based on feedback, re-do the assignment or proceed with the next exercise.

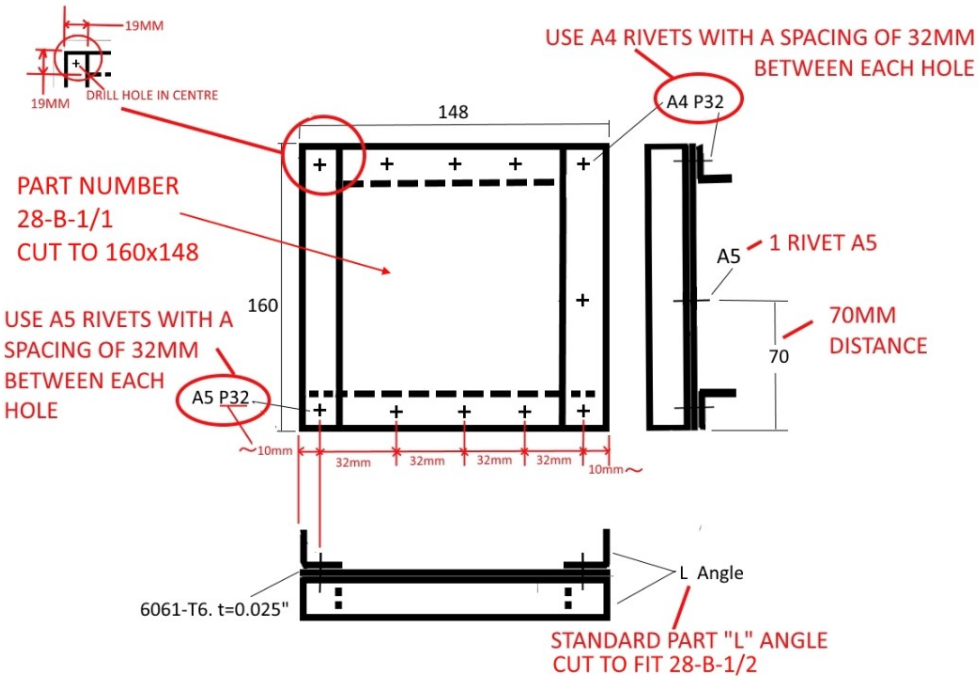
Note: Use safety equipment (safety glasses, gloves, etc.) as per local requirements.

ASSEMBLY TRAINING – Exercise #1

The following drawing (28-B-1-1) is to be used for assembling the first training assignment in this program. Send pictures of finished assembly to Zenair.info@gmail.com

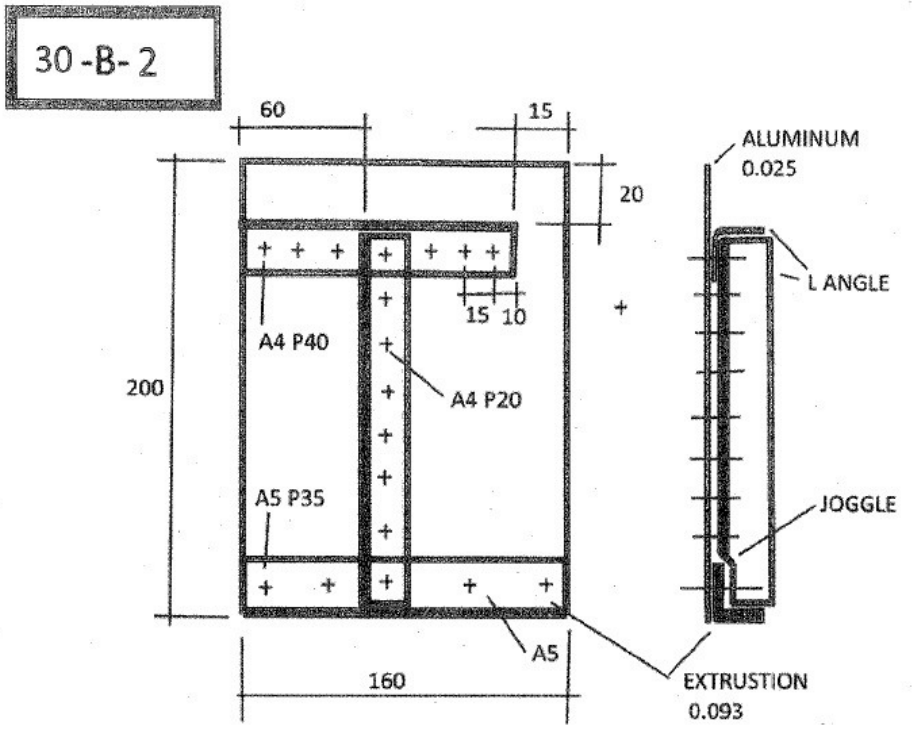


Based on the information provided in the previous Sections of this manual, you will find much data contained in the above drawing. Following are some of the important details:

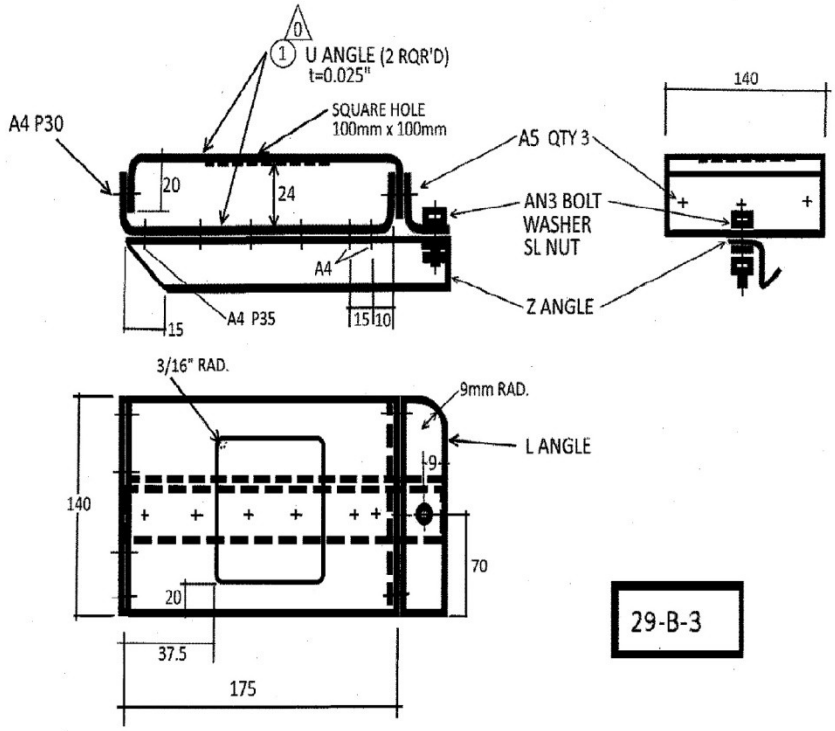


Use all information from the drawings, and all instructions provided in this manual to complete this assembly - then do the same for the other two! Drawings are provided separately (3 pages).

ASSEMBLY TRAINING – Exercise #2 (see separate sheet for full details)



ASSEMBLY TRAINING – Exercise #3 (see separate sheet for full details)



Section 13: Supplementary Pictures on How to Install an Angle

Draw a line as shown, on the center of the flange on the angle

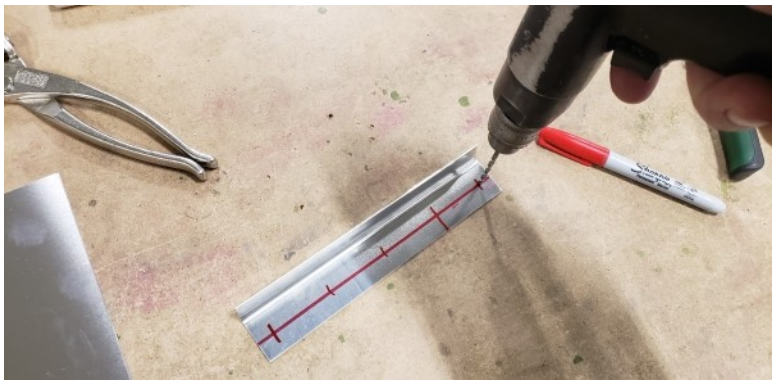
Mark where the rivet hole will be going on each end of the angle.

This is approximately 10mm from each end.

Mark the rivet hole Pitch “P”.

The angle is now ready to be drilled.

Drill 1 hole at one end as shown. Drill into the workbench table.

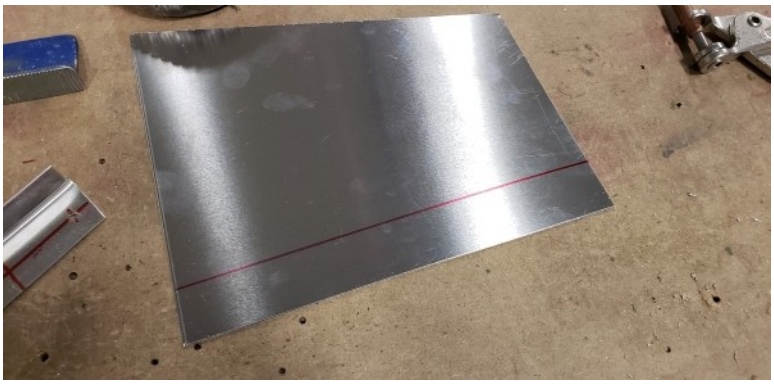


Get ready to install a Cleco in the first hole.

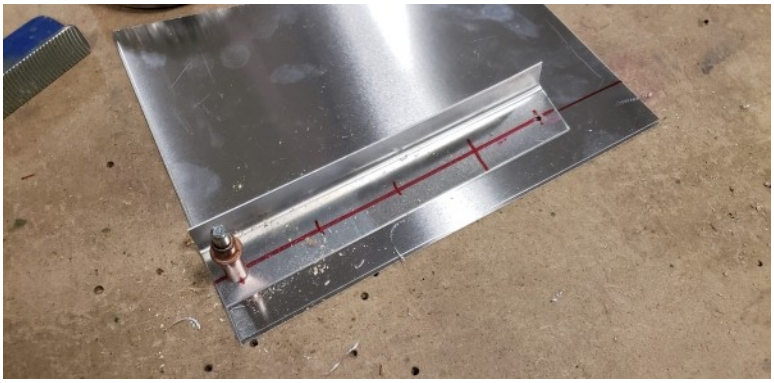
Install the Cleco so that it is fixed into the workbench.

Drill and Cleo as shown.

Mark a line as shown on the aluminum sheet where the angle will go.



Through the drilled hole in the angle, locate the line on the aluminum sheet, drill and Cleo as shown

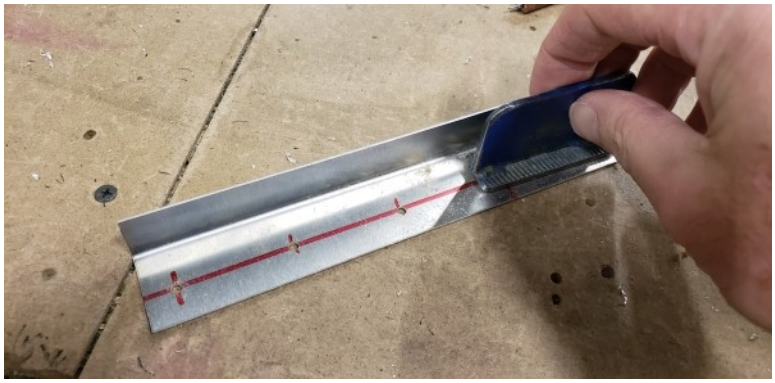


Position the second angle-hole also to the line in the aluminum sheet, drill as shown.

Cleco as shown.
The angle is now well-positioned and secure onto the aluminum sheet…

Drill the remaining holes

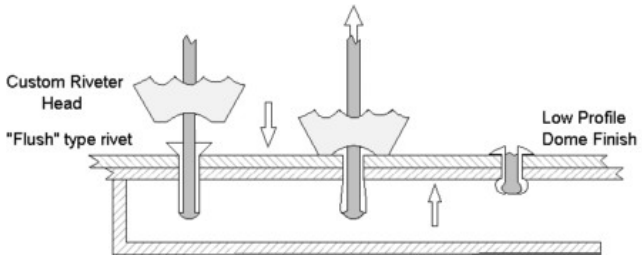
Remove the Cleos, and deburr the parts so that they are smooth. Use a file or Deburring file as shown. Move the file over the holes to remove the burrs



The parts are now ready to be riveted together.

IMPORTANT!

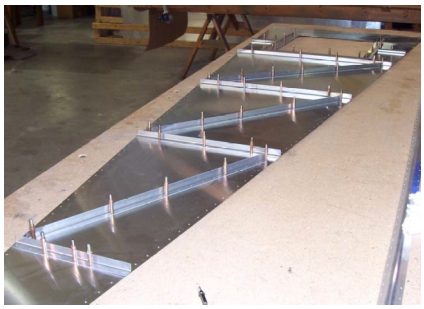
When riveting your Zenair parts together, make sure to use the special Zenair **blind rivets** supplied with the kit(s) and set these rivets with the special MODIFIED RIVETER HEADS (see **Section 5** above)!



SECTION 14: Matching, Drilling & Riveting "Longerons" to Pre-drilled Skins*

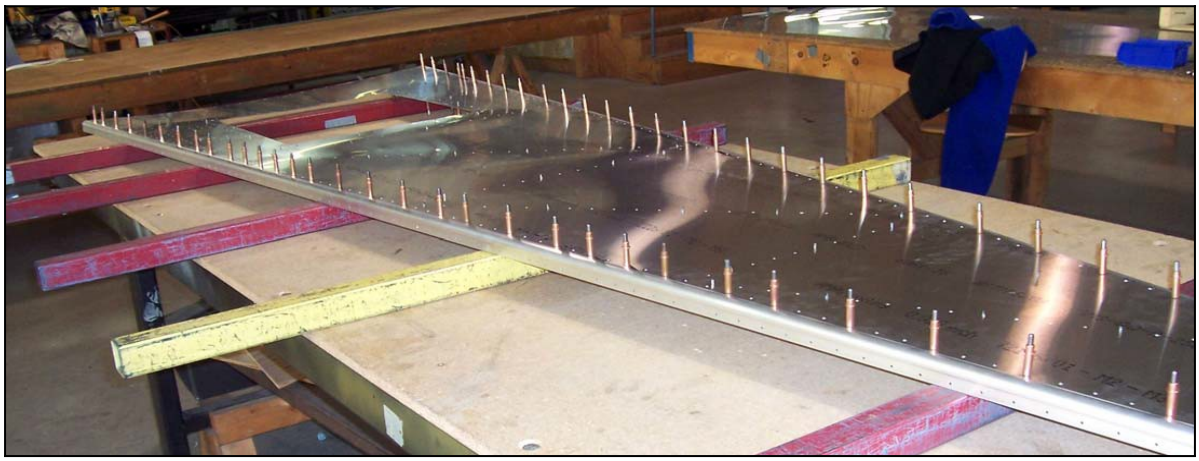
The four primary fuselage **longeron extrusions** are not always factory pre-drilled with some Zenair-supplied airframe kits. When this is the case, you will need to follow the steps below:

First, position and cleco all the stiffener "L" angles onto the Fuselage bottom and side Skins (as per drawings).



Then, position a full-length Longeron along one side of the Bottom Skins. The Longeron is properly positioned when the skin is against the lip on the Longeron, at the start of the radius. Position the Longeron so that there is excess material at each end of the skins; this will be trimmed later.

Back drill through the pre-drilled holes in the Skins, into the Longeron, and Cleco in place. Expand the holes with a #30 drill bit if necessary. Repeat with a second Longeron, on the other side of the bottom fuselage Skins. For more detailed step-by-step instructions, refer to the CH 750 Rear Fuselage Skins Photo Assembly Guide: Section 75-FA-1



Next, position one of a fuselage side (below) and support it in place so that it, too, rests against the "lip" of the extruded aluminum Longeron (at the start of the radius). Again, back drill through the pre-drilled holes in the Skin and into the Longeron; used Cleco to hold skin in place. Repeat this process with the opposite fuselage side skin as well as with the top skin!

* A video of this process is available.

SECTION 15: "Finishing" or "Prepping" Ribs

Depending on the airframe kit being assembled, some ribs (found in the wings, tail sections, etc.) may need a little "tweaking" prior to installation. The reasons for this can be due to the initial manufacturing process, or because of deformation or damage that may have occurred during the transportation of the kit. In any case, the tweaking process is very quick and easy: It simply entails making sure that rib flanges are perpendicular to the rib web and that the rib web lays fully flat (without a twist) when laid web-down on a table-top.

It is important to insure that all rib flanges are perpendicular to their web so that the flanges will fully contact all adjacent skins. Perpendicular flanges will facilitate the riveting process and will also ensure the structural integrity of the "box" structure being assembled. There are two steps to "Finishing" or "Prepping" the ribs for assembly:

1) Checking the ribs
2) Finishing/Straitening the ribs (if necessary).

The verification process only takes a few seconds per rib, and if an adjustment is necessary, a few seconds more will remedy the situation. The two hand-tools needed to make the adjustments are hand-seamer pliers and crimping pliers (illustrated below).

Crimping Pliers

Hand Seamer Plier

Typical Crimping and Hand Seamer Plier (Note: Masking tape on the pliers is not mandatory but can help minimize tooling marks on the parts).

HOW TO "FINISH" OR "PREP" THE RIBS

Step #1: Inspect each rib

Lay each rib down flat (with flanges facing up) on a table and inspect:

a) Is the "web" contacting the table everywhere and not lifting off the table in any corner (no "twist")?
b) Are the rib flanges perpendicular to the table all around the rib?

If the answer is "yes" to both above questions, the rib is ready for installation. Skip step #2 and set rib aside; check next rib.

Step #2: Finish, Fix or Prep

If a flange is not perpendicular, use the hand-seamer pliers as illustrated below and gently bend the offending flange in or out until it is perpendicular to the table.

Pictures below show the seamer pliers used to straighten the rib flanges before installation. Finished ribs must be flat on the table. Use the Seamer Plier to help straighten the flanges

If a rib is twisted, use the crimping pliers as illustrated below and apply gentle pressure to one or more crimps until the twist has been worked out.

Pictures below show the crimping pliers used to straighten a rib before installation.

SECTION 16: Supporting Documentation

The following documents are available from Zenair to all builders/owners, for the assembly, maintenance and on-going airworthiness needs of their Zenair Aircraft design. It is the responsibility of the builder/owner to obtain or access this information as needed and to use it to properly build, maintain and operate his/her aircraft. Note: It is highly recommended that copies of some of these documents accompany the aircraft when it is sold…

1) PRIMARY DOCUMENTS:

The Construction (Assembly) Drawings. These are provided in printed form only, formatted on ledger (11" x 17") paper. The revision of the drawings (1, 2, 3, etc.) is usually indicated on the first page, as is the serial number to be assigned to the aircraft.

2) SUPPORTING DOCUMENTS:

These documents are typically supplied on a DVD with the Construction Drawings (above) at time of purchase. For the latest version of these documents (which can be updated by the factory at any time), go to the password-protected "Builder Section" of the Zenith Aircraft Website and view/download them from there: http://www.zenithair.net/builders-page/

a) Assembly Photo-Guides (available for Airframe, most Systems & Options)
b) Illustrated Parts Catalogs (available for most models)
c) Installation Photo-Guides (available for Engine & Firewall Forward)*
d) The IPL (mostly for the CH 750-SD and CH 2000)
e) The Zenair Designs & Construction Standards for Light Aircraft (DCS/CS)
f) Weight & Balance worksheets & instructions
g) Sample POH and Maintenance Manuals
h) Additional photos (construction & finished)

* Many other FWF Installation Guides are available here: http://www.zenairfwf.com/ (Contact Zenair for the password)

3) ON-GOING AIRWORTHINESS

a) Safety Alerts
b) Service Letters
c) Service Bulletins
d) Notification Letters
e) Sample POH

4) SAMPLE VIDEOS

Videos: Links to the following on-line videos are just a few of the hundreds available that can help builders & owners of Zenair aircraft designs – from building to flying the aircraft. Most of these videos were made and distributed by independent third parties and may show parts, features and/or building/flying techniques that differ slightly from original factory instructions. Therefore, use the information contained in these videos to your advantage, but with caution and at your own risk. If in doubt, check with the factory or consult your own aeronautical engineer or mechanic. Note: links may change & and new/additional videos can be found on-line every week. Zenair cannot be responsible for accuracy or appropriateness of the contents.

Before you start:

Zenair Design College/Zenith Technical Institute: http://www.zenithair.net/zenith-technical-institute/

Aircraft Riveting: Cordless Electric Blind Riveting Tool: https://youtu.be/wZ1AyGKvpy4

SolidWorks 3D model of CH 750 Cruzer: https://youtu.be/2XIqTdF5qnQ

Airframe Assemblies:

Overview of the Complete STOL CH 750 Airframe Kit: https://youtu.be/Rd03O3scodQ

Building the Zenith CH 750 Cruzer - Part 1: Internal Wing Assembly: https://youtu.be/4vwzuDyLdWA

Building the Zenith CH 750 Cruzer - Part 2: Bottom Wing Skins: https://youtu.be/UbZeb6Wo0IE

Building the Zenith CH 750 Cruzer - Part 3: Top Wing Skins : https://youtu.be/-lR0VkYqig0

Assembling the CRUZER CH 750 Wing at ZAC: https://youtu.be/Pd59GsX9Oa8

Assembling the STOL CH 750 Wing Kit: https://youtu.be/Sr9Pglm4_As

Building the Zenith CH 750 - Flaperons Assembly: https://youtu.be/F2lal0kPFDk

Building the Zenith CH 750 - Rear Fuselage Assembly: https://youtu.be/d4dVE5-2DaU

Building the Zenith CH 750 - Fuselage Assembly: https://youtu.be/DvKqbv-GTrQ

Building the Zenith CH 750 - Wing Assembly: https://youtu.be/Sr9Pglm4_As

Building the Zenith CH 750 -SD - Rudder Assembly: https://youtu.be/VmeBRHbHFrw

Building the Zenith CH 750 -SD – Wing Leading Edge: https://youtu.be/6RZYZzw4Eu8

Building the Zenith CH 750 - Flaperons Assembly: https://youtu.be/mHliA9nwJDo

Building the Zenith CH 750 – Top Wing Skin: https://youtu.be/LRqF_6yDySA

Building the Zenith CH 750 – Tail Assembly: https://youtu.be/C_Qk43eWsa4

Introduction to the Super Duty STOL CH 750 -SD wing kit: https://youtu.be/mHliA9nwJDo

HomebuiltHelp CH 750-SD Assembly - Part 1: https://youtu.be/U0E3Z_VkbBk

HomebuiltHelp CH 750-SD Assembly - Part 2: https://youtu.be/_DzrozHDIqs

HomebuiltHelp CH 750-SD Assembly - Part 3: https://youtu.be/DgEenkGzux4

HomebuiltHelp CH 750 Cruzer Tail Kit Assembly: https://youtu.be/awFIUTA_9Jk

HomebuiltHelp STOL CH 750 Airframe Assembly: https://youtu.be/4ewFXoUjztA

Riveting CH 601/650 ailerons: https://youtu.be/G1ix99LIiIg

Details:

Main Landing Gear Detail – The rubber spacers: https://youtu.be/eZVIhZGkqwE

Nose-Wheel Rubber Puck System for 650/750: https://youtu.be/WGavi2hkHic

701 Four-Position Flap Handle Option: https://youtu.be/OE3JXUoeFTc

Applying a Wrap (instead of paint): https://youtu.be/3q_IOzQso2I

Installing Cruzer Flaperon Counterweights: https://youtu.be/QG94SOuCtg0

Converting to New-Style Doors on CH 750 (pt 1): https://youtu.be/F83LHk2LEKE

Converting to New-Style Doors on CH 750 (pt 2): https://youtu.be/APE-zYlRqoo

Engine:

Viking 130 Installation on a CH 750: https://youtu.be/atGLgOjqI5o

Viking 180 Installation on a CH 750-SD: https://youtu.be/0PuIy7JYk3w

Corvair Fiberglass Nose Bowl/Cowl: https://youtu.be/DkSHhh9d19A

Rotax 912iS installation explained: https://youtu.be/TzTieV0EvSY

HomebuiltHelp - How to Pick the Best Engine: https://youtu.be/JXqBwIWSrDY

Propellers:

Testing a 64” Sensenich Prop on the CH 750Cruzer: https://youtu.be/uEjIbZQOGik

Testing Sensenich three-bladed prop on CH 750 Cruzer: https://youtu.be/oHIhdNBaCe4

Instruments:

GARMIN G3X Instruments/Avionics Package from ZAC: https://youtu.be/G9426BzfhXg

DYNON SkyView HDX Instruments/Avionics Pkg from ZAC: https://youtu.be/E_zvzAU9qvI

Flying with the "unpanel" panel: https://youtu.be/Jxq4ueNUwV4

Flying:

STOL Flying – Tips & Techniques from Roger: https://youtu.be/JkgT81awYYc

Let's go flying: a Rotax 912iS-powered STOL CH 750: https://youtu.be/9_lscMlJT1Q

Ultimate Off-Airport Flying: Zenith STOL "Sky Jeep": https://youtu.be/Gc9SZ0ysqto

CH 701 flying with the Dynon Avionics D2 Pocket Panel: https://youtu.be/kQuto2ma6pQ

Sky-Jeeps and Extreme STOL (2017): https://youtu.be/2J6maI4q_-8

Deadstick (no power) landing in the CH 750 Cruzer: https://youtu.be/TwFmLcaDDGA

More….

For Zenith Builders, from EAA (requires EAA membership):

http://www.zenith.aero/profiles/blogs/hints-for-homebuilders-video-series-from-eaa

The complete series: One Week Wonder (2014) – Zenith Ch 750 Cruzer:

http://www.zenith.aero/profiles/blogs/return-of-the-one-week-wonder

Jeff & Adam's Videos - Building your own CH 750:

https://www.youtube.com/channel/UC3l-N-mLwiCo2ZZIO-j9u_g/videos

Tips on how to paint your CH 750: https://youtu.be/77sfq_E2c8s

More tips on How to Paint your plane: https://www.youtube.com/watch?v=FCoVqSSB8DY

"Why I chose the Zenith STOL CH 750": https://youtu.be/EF3HceM4wh0

HomebuiltHelp "Tips of the Week": https://www.youtube.com/user/HomebuiltHELP/videos

Add your own:

CONCLUSION

Finishing a commercially-assembled Ready-to-Fly (RTF) Zenair kit aircraft:

After having successfully assembled a Zenair design from a Zenair-supplied kit, the finished aircraft will still need to be thoroughly inspected prior to flight, and thoroughly flight-tested prior to delivery. The **Quality Assurance** and **Testing Protocols** for these important steps go beyond the scope of this introductory Aircraft Assembly Training Manual, but depending on the Commercial Agreement signed between the Assembler and Zenair, these are also available from Zenair.

For additional information on this subject or on any aspect of the aircraft assembly process as outlined in this manual, please contact Zenair directly:

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