T-18 BUILDING INSTRUCTIONS

Those of you who are relatively new EAA members might not have all of the Sport Aviation magazines in which John Thorp's T-18 building instructions appeared. For your convenience, the issues in which articles appeared are listed below. Copies can be obtained from EAA Headquarters or from your EAA friends. You really should have them to build the T-18. If there is enough interest, we could have reprints of these articles made.

Part I	General	May - 1962
Part II	Outer Wing Beams	June - 1962
Part III	Wing Ribs	July - 1962
Part IV	Assembling Wing Panels	August - 1962
Part V	Ailerons	September - 1962
Part VI	Fin	November - 1962
Part VII	Progress Report	December - 1962
Part VIII	Rudder	April - 1963
Part IX	Fuselage	June - 1963
Part X	Fuselage	July - 1962
Part XI	Landing Gear	March - 1964
Part XII	Engine Mount	March - 1964

- L.D. Sunderland, 5 Griffin Dr., Apalachin, N.Y.

BUILDING THE FUSELAGE - Here are a few tips that might help other builders in building the fuselage. Follow parts 9 and 10 of Thorp's BUILDING THE T-18 articles. Everything works fine just as the instructions specify. It is of considerable help in squaring up the fuselage during assembly if the #523-1 bottom skin is laid out with enough excess metal to extend across the main spar cutout and overlap the 523-2 floor. This permits the two bottom skins to be clecoed together for better alignment.

Some people have found it difficult to obtain 16 ft. lengths of 3/4 in. angle. Merrill Jenkins, Harbor City, Calif., has these for $65. He also has all other extrusions for the T-18. It is feasible to use shorter lengths of extrusions and splice them. For instance, G. Schiller, 736 Christianson Ave., Madison 14, Wisconsin has 12 ft. lengths for only $2.40 each. You'll need at least 9 of these. You can also save about $15. on the side skins by obtaining two 4 x 12 ft. sheets and making a flush splice between station 159 and 179. Use a piece of .032 or .040 material for doubler backing.

In Part X, John states that the curvature should be put in the longerons before assembly. He has since found that the longerons can be riveted to the skins in the flat condition before being assembled. They are then bent to shape as the skins are clecoed in place on the fuselage. This ensures that the skins are drawn tightly against the longerons since some waviness will occur if the longerons are bent and holes are transferred on assembly. I was skeptical of this procedure and found it very easy to bend the longerons to the proper curvature with a jig made by Don Carter.

For a bending jig he sawed a 12 in. radius along the edge of a piece of 2 x 4 , one foot long, then made a saw cut along this same edge about 1/16 in. wide and over one inch deep. He then nailed this block to a table and nailed another back up block about 1/4 in. away from the cruved edge. By slipping one leg of the angle in the saw cut it was a simple matter to progressively bend the angle to any desired curvature. These angles were riveted to the skins, while they were off the fuselage assembly. During hole transfer from the skin to the longerons, the longerons were held nearly flat. Then when they were put into the assembled fuselage, the skins were drawn tightly against the longerons. It was difficult to detect the lightly scribed for and aft center lines on the longerons for hole transfer until I found a simple cure. I sprayed a coating of zinc chromate on the longerons before scribing them. This made the scribe lines show up. The -3 longerons should be cut off at a 30 degree angle to make sufficient clearance for the rudder.

You should have no trouble with the matched hole tooling technique on the fuselage except possibly on the top rear skin. When the skin is mated with the fuselage frames any slight misalignment will cause "oil cans" in this skin. Since other builders have experienced this problem I chose to take a slightly different approach in transferring the holes from the skin to the frames. I first drilled all of the holes in the skin except along the side flanges. Before bending the flanges down I transferred the top center line holes from the skin to the frames. With these center holes located I then used transfer strips to locate the remaining holes. It is important to remove any twist in the fuselage before the center line holes are transferred.

Bending the flanges on the top skin was done very simply by bending it over the edge of a board with the curvature of the top skin sawed along the edge. I bent up some small test samples first to determine where to place the skin relative to the edge of the board. After the flange was bent down to 45°, I marked the location of each rivet hole and then, using a homemade crimping tool, put one crimp between each rivet hole to draw the skin down to meet the fuselage frames. The 580-1 "hip" skins were made in a similar fashion. Care should be taken not to extend the crimp very far into the flange or it will be visible after assembly.

MAKING THE FIN - Dr. B. John Shinn, 3141 Cornell Avenue, Vestal, N.Y.

In Part VI, BUILDING THE T-18, Nov., 1962 Sport Aviation, Thorp said, "When the fin is done you are the master of the T-18 project. No other component is harder to make." But, when the time came for me to make the fin, I was definitely not yet ready to make the hardest component on the T-18. I was, of course, spoiled at this point by the relatively easy assembly of the matched hole techniques which were used on the wing panels and stabilizer. They are rectangular in principal view and lend themselves readily to this approach. Not so with the eye-pleasing but trapezoidal fin. To get around this problem I have figured out a way to make a very simple fin jig. With it I found that the job of building the fin turned out to be easy, fast and a lot of fun.

I must admit the problem of supporting the skeleton (ribs and beams) assembly of the fin, as suggested in the article, (so that its center plane was held 3 inches above a table by lots of clamps and blocks), had me a little concerned. The problem gnawed at me for quite a while and gradually the idea evolved that what I wanted was some way of holding the skeleton in rigid alignment which would allow me to fit and drill the skin simultaneously and symmetrically on both sides over the skeleton. But how? All of these things at once aren't so compatible. Any rigid jig would have to come through one side or another of the skeleton to be supported. But, the only side that wasn't to be fitted with the skin was the backside, -- the beam. That's it! A jig that fits through some holes in the beam! Now all I had to do was figure out how. Since it had to be cheap and relatively easy to make, I ruled out metal welding, etc. Thus wood was used; 2 x 10's (all as square and true as possible). The basic idea was to clamp the rear fin beam between two blocks of wood to which the ribs could be screwed and held in rigid alignment. The clamps and the blocks could not protrude beyond the width of the ribs. Figure 1 shows the basic idea of the jig.

The main jig spar made of a 2 x 4 is placed behind the 566-1 fin beam and two large blocks of 2 x 10 are clamped edgewise over the 566-1 fin beam. The clamping is done with four, 3/8-16 bolts, 6 in. long. Two large 1-1/4 inch holes in each block provide a place for the nuts of the 3/8 bolts. (My Sears Craftsman Powercraft wood bits were used to make these holes.) Washers are placed under the beads of the bolts as needed to keep from "running out of threads." The blocks are cut at exactly 8° off perpendicular (as shown on the fin assembly print) at the right position for the ribs to be clamped to them.

The 2 x 4 can be clamped in a vise to hold the jig assembly during the entire skin fitting operation. The ribs are "clamped" by long wood screws going into the end of the blocks. (Washers under the screw head will help distribute the load on the rib a little better.) The bottom rib is screwed to the bottom edge of one block while the middle and top ribs are screwed to the other block. If the blocks do not come out at just the right position, keep trimming them until they do. If you go too far, shims can be made of scrap aluminum, masonite, or thin plywood, depending on the thickness required.

If you want a really first-class jig, then you'll want to use rib blocks which support the ribs clear out to the front tips. (The 2 x 10's don't go the whole way to the tips and the ribs could be forced out of alignment if proper care is not exercised during the fitting of the fin skin.) These rib blocks are screwed to the 2 x 10's which have been trimmed so that the blocks will hold the ribs in the proper place.

Before the ribs are screwed in place, they are "clecoed" to the fin beam through the rivet holes and are "C" clamped to the blocks. A "C" clamp grasping between the 1-1/4 in. nut hole and the end of the block will do the job. The ribs are then lightly tapped into alignment before screwing to the blocks. The alignment can be done by: (1) sighting to a line, (2) using a flexible straight edge, and (3) laying the jig assembly on a flat plate (table) supported so that the center line is parallel to the surface. This last technique uses some wedges (made from scrap wood) which can be tapped for proper positioning. As a check, I used all three techniques. (Don Carter went a step farther and assembled the jig and fin beam on his fuselage so he knew the bottom rib was at the right position.)

From here on the job was just fun. Dimensions from the plans were used to layout a fin skin that had about 1/4 in. to 3/8 in. excess on all sides. The fin skin was cut out and then was bent by: (1) bowing the skin so that the trailing edges could be clamped together between two boards, and (2) squeezing the skin together by using a cloth wrapped 2 x 4 to push down on the skin as it lay on a table. You really have to lay on it to get the sharp radius that fits the ribs!! The 2 x 4 distributes the load so you won't get a "lumpy" bend. After several trials of bending, unclamping, fitting on the fin skeleton, reclamping, and <u>really pushing down</u> hard you'll decide its a good fit.

The skin is then held and clamped down in position on one side of the skeleton while the other side is lifted up like a flap so you can reach in and trace on the skin along the bottom edges of the ribs with a pencil. Observe the gap between rib and pencil line. This much must be added to the .250 rivet edge distance when you mark the center line of the rivet pattern for each rib. Measure up the proper distance from the traced line and draw in the rivet pattern center line. Drill a 1/16 in. hole at the foremost rivet position that you can with the drill you are using. (This will be from the inside of the fin skin, of course.) Now mark all ribs with pencil at .250 inches from their bottom edges (i.e., the rivet center line). Reposition the skin over the skeleton sliding it until the center line on the rib shows through the 1/16 in. hole in the skin. Drill through the skin hole into the rib with the 1/16 in. drill while holding the skin firmly by hand on the rib leading edge. Both holes (rib and skin) can now be drilled out to a size 30 and a cleco inserted. The pencil lines are rechecked for shifting, etc. The skin is removed and an undersize hole is drilled at the rivet position closest to the fin beam. The skin is again fit on the skeleton and clamped with the front cleco. The back rivet hole is checked for alignment with the pencil line on the rib. If it is close enough, then proceed. (Otherwise, check for reasons and decide on either (1) extending the undersized hole sideways with a file meet the pencil line, or (2) perhaps flexing the skeleton a little.) When you're satisfied with the hole alignment, connect the front and back holes with a pencil line. Mark off rivet positions and drill small pilot holes. Then ream out with a No. 30 drill, putting clecos in as you go.

By removing all but the top cleco this side can be pulled up like a flap so that the opposite side ribs can be traced along to determine the rivet line. Repeat for all ribs. Be sure to put clecos in as you drill. This prevents bulges and warping. You may now trim the skin to size. The only thing left is putting in the rivet holes for the fin beams (front and rear).

The little front beam can be clecoed in position on the bottom rib. By opening up one side of the skin you can reach in and push up firmly on the top end of the front beam. While holding it in position you can sight up along it edgewise from the bottom and draw a rivet center line for the straight position. Check by several resightings and drill a hole. Check edge distance on the beam and proceed with other straight line holes accordingly. To get the holes along the curved portion, remove the front beam and make a transfer template on the beam. Include holes to be drilled as well as those already in place. Reinstall the front fin beam and cleco the template on the skin and drill the remaining holes.

If the rear fin beam was not punched before fitting the skin, then the same procedures as described above can be used. If it is already punched, then it is necessary to transfer the holes to the skin. At the top, where the overhang of the skin is not too great, the Whitney punch can be used to punch through directly. At first it would seem the hole is on the wrong piece to do this, since you can't get the punch inside the channel of the beam to index on the hole. This problem can be circumvented by a neat little trick we learned. Slide the punch over the two thicknesses of metal (skin and spar) with the die on the spar side and the punch on the skin side. Then push a long 1/8 in. rivet up through the die of the Whitney punch and hold it in place lightly against the underside of the beam. Slide the Whitney punch around until the rivet drops in the rivet hole already punched in the beam, and then squeeze. The rivet is pushed down through the die by the punch and the plug from the new hole.

Where the overhang is too large for the Whitney punch, a long 1/8 in. transfer punch can be used. Push it through the holes in both flanges of the fin beam, lifting first one skin as a flap and then the other.

With a great deal of care you could drill through this hole in the beam, but it's tricky and you might enlarge them. The fin is ready for riveting!!

While the description of how to do the fin may seem pretty involved, the actual job is pretty easy. The next guys in line will really think it easy since the jig is already built.

HI SHEAR RIVETS - As some of you have discovered, John Thorp has run out of the Hi Shear kits which he had been selling. He was doing this as a service to builders but now with his present work load, cannot continue to make up the kits. Unfortunately, Hi Shear has no distributors and they will not sell rivets in quantities less than 100. John says that it is perfectly alright to use AN bolts with elastic stop nuts. Hi Shears were specified only because of a slight price advantage.

I wrote to the Hi Shear Company and asked them to make up kits but they only would quote prices on quantities of 100 of each type. The prices average about 14 cents each including collars. If there are at least 50 persons interested in kits at about $15. each, I shall consider making them up. If you are interested, just send your name and address to me, Lu Sunderland, within two weeks. If there is sufficient interest, I'll put a notice in the next newsletter and everyone who wishes to order can send me a check. They require payment in advance.

NOTE: Word has been received that Mrs. Cavin had a heart attack over the weekend and is now in the hospital. Everyone sends their wishes for a speedy recovery. Wherever possible, please send all correspondence regarding the T-18 to L.D. Sunderland, to give Dick a break.

MATERIAL LIST - Everyone has been waiting for someone else to make a material list, but no one has made the grade. Now that I have about all my aluminum, I'll pass on the breakdown as far as I've gone.

2024-T3 Alclad .025 " x 4' x 12' 7-1/2 sheets

Sheet Number	Use
1	Outer wing skin 82" plus 2 fus. frames
2	Outer wing skin 82" plus forward upper skin
3	Inboard wing skin 90" (includes flap junction) plus fin skin.
4	Inboard wing skin 90" plus 2 fus. frames
5	Top fuselage skin plus bottom fus. skin
6	Fuselage side skin and "hip" skin
7	Fuselage side skin and "hip" skin
8	Two stabilizer skins

Note: Sheets 6 and 7 can be replaced by one 5' x 15' sheet eliminating splice but costs about $10. more. Sheet 2 makes a close fit on the upper skin. The other half of 8 would be better for the upper front skin.

6061-T4 .025" x 3' x 12' 1 sheet

Ribs for wings, fin and stab.

2024-T3 Alclad .016" or .020" x 3' x 12' 2 sheets

1	Ailerons, stab tab and rudder
2	Flaps (half sheet approx.)

2024-T3 Alclad .032 x 4' x 96" 3/4 sheet

Frames, beams, etc.

2024-T0 or 6061-T4 .032 x 4' x 72" 1/2 sheet

Frames and ribs

2024-T0 or 6061-T4 .040 x 4' x 24" 1/6 sheet

Ribs, fuel tank support etc.

2024-T3 .040 x 4' x 12' 1 sheet

Main spar, floor (enough for 3 airplanes)

Call Reynolds Aluminum Louisville Kentucky

T-18 BUILDERS

D. Underwood
1505 Toplea
Euless, Texas

Mark Allen
PO Box 15
Palos Verdes
Estates, Calif.

John Wall
5649 Colorado Dr SW
Cedar Rapids, Iowa

Marion Hawk
5513 Laurette St.
Torrance, Calif.

Ed Seversen
679 N Wells St.
Chicago 10, Ill.

John Foy
299 Edith Dr.
W. St. Paul 18
Minn.

Edward Burke
250 Franklin Dr.
Bridgeville, Pa.

Donald Patterson
1558 N 400 West
Sunset, Utah

Barrett Kemp
118-c 19th St.
APO 953
San Francisco, Cal.

Fred Young
2521 Clement Ave.
Alameda, Calif.

Merle Soule
4026 Walnut Hill
Lane
Dallas, Texas

John Adams
5424 Arbor Vita
Los Ang., Calif.

Wm. Baugher
6258 S Park Ap 6
Tucson, Airzona

Jack Danks
Box J
Kellog, Iowa

C.R. Burden
1241 E. Harding St.
Long Beach 5, Cal.

R.K. Cavin
10529 Somerton
Dallas, Texas

Russell Highbridge
7 Mead Circle
Ansonia, Conn.

Wm. Graham
10950 Coconino Dr.
Blythe, Calif.

Francis Richardson
2608 W Johnston St.
Denison, Texas

Louis J. Nelson
7121 N Figuero
Los Ang. 42 Cal

Paul Ollenburg
1114 W J-8 St
Lancaster, Cal.

Alvin O'Brien
140 Bluefield Ave.
Newbury Pk. Cal.

H.D. Rassler
98 Constitution Av.
Henderson, Nevada

Frank Miller
807 Terry Ave.
Billings, Montana

Herbert Baumgarten
61 Gettysburg Dr.
Springfield, Ill.

Eric Rawson
c/o Dpt. of Physics
Univ. of Toronto
Toronto 5, Canada

F. Stewart King
PO Box 3
Warden, S. Africa

John Woerhle
c/o Rudy Paulic
1834 106th Ave.
Oakland 3, Cal.

Joseph Moro
E. Main St.
Mendham, N.J.

Dean Cochran
42429 S Washington
Englewood, Colo.

Francis Schwartz
8905 48th Ave.
College Park, Md.

Erwin Horneman
75 Ambleside Dr.
Brampton, Ontario
Canada

Otto Zauner
MR-14 R-47
Vineland, N.J.

Edw. Sherratt
2236 N Line St MR
Lansdale, Pa.

Chas. Cummins
114 E 15th St
Metropolis, Ill.

Ralph Thenhaus
6536 Colbath
Van Nuys, Cal.

Frank Roncelli
922 E Marcheta
Altadena, Cal.

Eric Carlson
14 Hempstead Rd
Spring Valley, NY

Richard Hanson
11035 Sutter Ave.
Pacoima, Calif.

Wm. Petty
12282 W Mississ. Av.
Denver 28, Colo.

Stanley Zapalik
3820 W 28th St.
Chicago 23, Ill.

Floyd Roberts
5902 LeMay Rd.
Rockville, Maryland

Gordon Weidenfeller
3128 Homewood St
Grandville, Mich.

Joseph Robinson
561 NW 65th Ave.
W Hollywood, Flor.

Rudy Adler
13503 Cheltenham Dr,
Sherman Oaks, Cal.

Harry Dittmyre
247 Beech St
Kearney, NJ

Floyd Wilson
8531 Whitefield
Dearborn 6 Mich.

Lorran Pugh
1301 S Jennings
Bartlesville, Okla.

Lt L.W. Sisson
VR-21 Det. Japan
Navy 3835 c/o FPO
San Fran., Cal.

Paul Hintgren
1390 W Glenhill Dr.
Glen Ellyn, Ill.

Owen Jacks
Box 1021
Solvang, Cal.

John Brewer
1009 Pemberton
Ft. Wayne, Ind.

Robert Wolfe
Rt 1, Box 17A
Buttonwillow
Calif.

Edw. Wolfe
Rt 5
Menomonie, Wis.

Jas. Evans
4737 45th Ave NE
Seattle 5, Wash.

Raymond Moore
16402 Purche Av
Gardena, Cal.

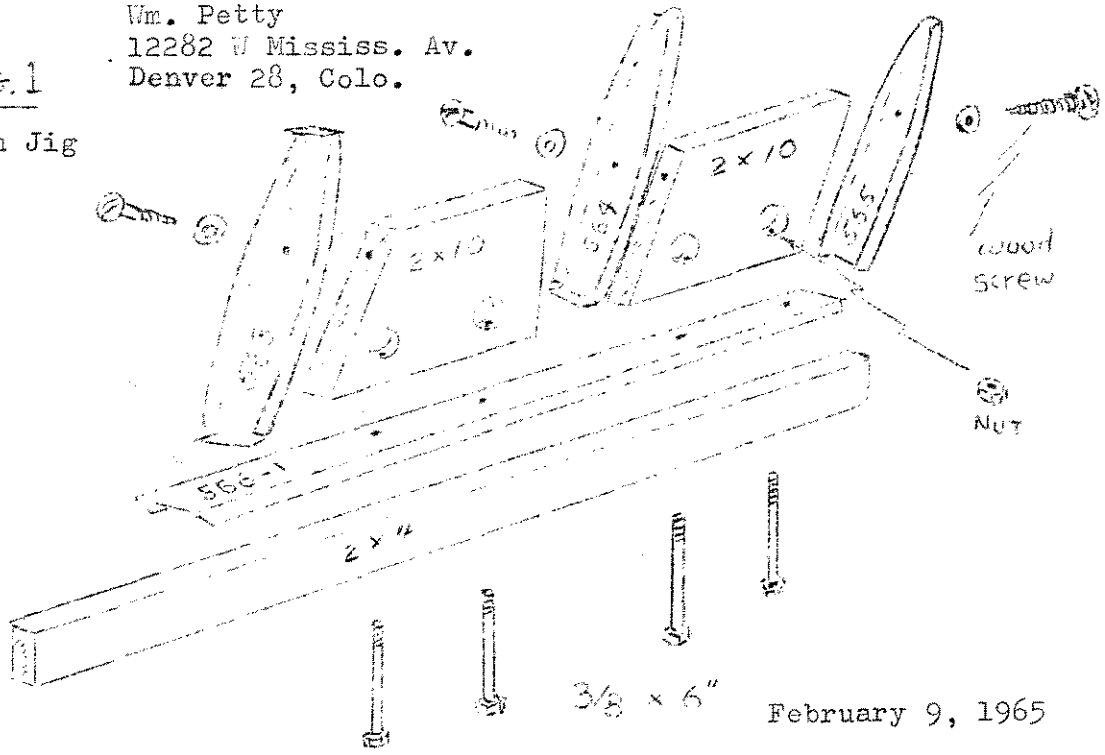
Jas. Dicks
6364 ElCamino D
Redding, Cal.

Raymond Page
8392 Bonnie Brae
Buena Park
Cal.

Max Potter
Box 338
Stanfield, Ariz

Fig. 1

Fin Jig



February 9, 1965