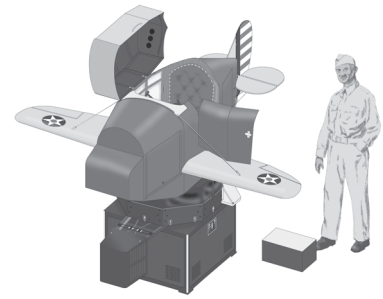


Assembly Instructions for the Link Trainer



Edwin Link and his trainer: a brief history

The Link Trainer holds a significant place in aviation history. It was the first true flight simulator, providing safe and realistic training to hundreds of thousands of student pilots during the 1930s and 40s.

Edwin A. Link (1904–1981) began work in the 1920s at his father's piano and organ factory in Binghamton, New York, but his true interest was in flying. In 1927, when he received his pilot's license, flight training was expensive and often dangerous, and Link began thinking about better ways to instruct student aviators. Using skills gained working at his father's factory, and his own flying experience, he designed and built a "pilot trainer" which he patented in 1931.

The trainer provided a truly realistic depiction of flight. The controls and instruments were identical in appearance and operation to those in real aircraft, and conditions such as icing and turbulence could be simulated. Full 3-axis movement was achieved by the use of pneumatic bellows for roll and pitch and a motorized turntable for turning. Lessons were supervised by an operator who sat at a nearby desk. The operator could simulate weather conditions and radio beacons, as well as transmitting instructions to the student pilot. In addition, an ink plotter on the desk would automatically mark the student's flight path on a map to assist in navigation training.

In spite of these features, initial sales were slow, and at first the machine was more popular as an amusement park ride than as a training aid. Then in 1934, after several accidents involving aircraft flying during bad weather or night, the US Army Air Corps purchased six trainers to improve pilots' instrument skills. In the following years sales increased in the US, and other countries including Japan, Germany and the USSR purchased trainers.

When the Second World War brought about the need to train large numbers of new pilots the Link Trainer came into truly widespread use. Basic instruction in the "blue box" before proceeding to actual flight provided incalculable savings in time, money and lives. By the end of the war thousands of trainers had been built for use by the American, British and Commonwealth armed forces. Even today some of these early trainers are used to teach instrument flying.

After the war the Link Company continued the manufacture of flight simulators, increasing in complexity to match advances in aircraft design. Edwin Link, by now a wealthy man, left the aerospace business in the 1950s and began a new career, using his considerable engineering skills in the design of submersibles and remotely operated underwater vehicles. But he will be best remembered for his flight trainer. The Link Trainer was a technological marvel at the time of its invention, and its legacy can be seen in today's modern flight simulators.

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The Model

This model builds into a 1/24 scale replica of a World War II-era Link Trainer in United States Army Air Corps markings. A word of caution: this model is not suitable for assembly by young children, due to the use of sharp tools and the complexity of some assembly steps. Previous experience with card modeling is strongly recommended. If you have any comments or suggestions regarding this kit, I can be reached by e-mail at models@currell.net

Model parts are contained in the document **linkprts.pdf**. Print out the parts document on 8.5"x11" or A4 size white card stock suitable to your printer (67 lb. cover stock recommended).

Tools

Before beginning, you will need the following tools and materials:

- a) white glue
- b) a glue applicator such as wooden toothpicks or a small paintbrush
- c) scissors (optional)
- d) a sharp knife for cutting
- e) a flat cutting surface
- f) a ruler or straight edge
- g) a scoring tool or blunt knife for creasing the fold lines
- h) a long, slender tool such as a letter opener, for applying pressure to hard-to-reach places

Hints

- a) Select a well-lit, comfortable work area that will remain undisturbed when you are not there.
- b) Keep your hands and tools clean when working, to avoid getting glue on visible parts of the model.
- c) It's easier to stay organized if you only cut out those parts you need for each step.
- d) Make sure your knife is sharp. When cutting straight lines, use a straight-edge. Scissors, if used carefully, can be used for large curved parts.
- e) Study the diagrams carefully, and always test-fit the parts before applying glue.
- f) You may wish to colour the edges of the parts to make seams less visible. Pencil crayon or paint applied with a fine brush can be used (experiment on scrap pieces to see what works best).

Assembly

In these instructions, the directional terms are given from the pilot's point of view. "Port" and "starboard" refer to left and right sides respectively. Scoring of parts is indicated by thin black lines outside the part's outline or by dashed lines or coloured lines on the part's surface. Score parts *before* cutting them out. In the diagrams, subassemblies are identified by a number within a circle (e.g. ②), corresponding to the step in which it was assembled.

Attach reinforcing strips to the turntable base (**step 1**). Assemble the side walls (fold top flaps onto the inside surface) and attach to the base (**steps 2,3**) with the sides marked "Front" facing the same direction. Assemble the fuselage platform (**step 4**) ensuring the upper surface of A7 is attached flush with the top edge of A36. Glue to turntable, with the bottom flaps inside the turntable walls (**step 5**). Attach the motor mounting rails and air hose (**step 6**), ensuring the light blue markings on the rails are on the protruding ends, facing upward. Assemble the motor housing and slide onto the rails, as indicated by the light blue markings, then add belt tightener A6 (step 7). Assemble the spindle and glue into slots in base bottom (**step 8**). Assemble the foot step and attach it and the lock bars to the turntable (**step 9**).

(**Step 10**) assemble base walls and attach top plate A29 (flush with top edges of walls). Glue reinforcing strips to the inside of the top plate at the four corners, ensuring the round hole is not obstructed, then attach inner plate A22 to these strips. Press turntable into base assembly (**step 11**). To allow rotation of turntable, do not glue. Assemble the tool box (**step 12**).

(**Step 13**) glue floor parts together and bend to match the profile shown in the diagram. Assemble simulator cylinders and control column base (**steps 14, 15**). Fold and glue the control column, glue it into the column base, and attach parts B30, B32 and one of the cylinders (**step 16**). Attach the control column assembly to the floor, assemble and attach the rudder pedals and the two remaining cylinders (**step 17**).

Glue the front wall parts together (**step 18**). The edges should line up except at the bottom, where B2 overhangs B34 slightly. Glue the front section parts together (**step 19**), taking care to align the parts as shown in the diagram. Add access panels (**step 20**) to the outside surface as indicated by the light blue printed shape. Glue the front section to the front wall (**step 21**). Begin gluing at the top, lining up the small printed arrows on the inside surface. The outer fuselage skin should overlap the edge of the front wall as shown in the diagram.

Glue the centre section parts together (**step 22**) and, if desired, separate the door (**step 23**) using the black printed line to cut. Put the door aside for later assembly. Assembly will be easier if the centre section and the open end of the front section are bent to match the profile shown in the diagram. Glue the centre and front sections (**step 24**) ensuring that the outside skin edges butt against each other. Begin at the centre and work down the sides. Attach the top plate A37 using the light blue printed shape for location. Bend inward the walls at the rear of the centre section, to close the gap at the top of the wall. Join the instrument panel parts and glue inside the fuselage at the gap between the inner surfaces of the front and centre sections (**step 25**). Attach strips A31 and A32 on the inside walls below the instrument panel. Also assemble the control box and throttle and attach to the inner fuselage walls as shown. Join the floor assembly to the fuselage (**step 26**). The outer fuselage skin will overlap the floor edges as shown in the diagram.

Assemble the seat support (**step 27**), the seat cushion (**step 28**) and the control wheel (**step 29**). Glue the cushion to the seat support, then attach to the fuselage assembly (**step 30**). Attach the wheel to the control column.

Attach connecting strips to the backrest (**step 31**). Add access panels to the rear fuselage skin (**step 32**). Wrap the fuselage skin around the backrest, beginning at the top centre (**step 33**). Ensure the front edge of the fuselage skin is flush with the front surface of the backrest. Assemble the internal structure (**step 34**) with the inked surface facing inward. Glue this structure into the rear fuselage, ensuring the bottom edges line up with the fuselage edges (**step 35**). Take care that the fuselage does not become skewed when doing this, especially at the narrow end. Add the tail plate. Join the rear and front fuselage sections (**step 36**), ensuring the outside skin edges butt against each other. Add the front fan cover and the side vent (**step 37**).

Assemble the port wing structure (**step 38**). Wrap the wing skin around the structure, such that the skin at the trailing edge lines up (**step 39**). Note that the national insignia on the wing faces upward. Fold upright the small triangular flap at the edge of the aileron opening and bend the wingtip strip to fit between the upper and lower wingtips. Fold and glue the aileron (**step 40**) and attach to the wing as shown. Attach the wire bracket to the top of the wing. Assemble the starboard wing as a mirror image of the port wing (**step 41**). Glue the wings to the fuselage using the printed shapes on the fuselage sides for location (**step 42**). The top surface of the wings should be at right angles to the fuselage sides. If desired, attach wires between the wing brackets and the fuselage top plate using thin wire (28 AWG or similar) or silver thread stiffened with glue.

Assemble the rudder and hinge posts. Join the tabs on the hinge posts to the slots in the rudder before attaching the final rudder surface part (**steps 43, 44**). Bend together the edges where the outer surface overhangs the centre part to form a rounded edge. Assemble the elevators and horizontal stabilizer in a similar manner to the rudder assembly (**step 45**). Glue the struts and actuator brackets to the elevator assembly (**step 46**) and join to the fuselage using the light red marking on the tail plate to position the bar joining the horizontal stabilizers. Note that there is a small gap between the horizontal stabilizers and the fuselage. Add handle B10 to the side of the fuselage. Attach the rudder to the fuselage using the light blue markings on the fuselage and tail plate for location (**step 47**).

Join the inner and outer parts of the canopy wall (**step 48**), and glue together as shown in the diagram. Attach the inner roof sections to the outer roof (**step 49**) and bend into a curve to close the gaps in the outer edges (the yellow surface bends outward). Glue roof ribs to the inside of the roof to cover the gaps between the inside sections. Glue the roof to the canopy walls (**step 50**). Attach the control box C7 to the inside front, and the handle and vents to the outside of the canopy. Attach the canopy support C10/C11 to the starboard side.

Assemble the door (**step 51**). Attach door to fuselage in the open position (at right angles to the fuselage side). Assemble and add the lamps (**step 52**), using the light blue pads on the inside fuselage and door for location. Attach the canopy to the fuselage in the open position (**step 53**).

Glue the fuselage to the base (**step 54**) using the printed shapes on the base and underside of fuselage for alignment. Join the figure halves. The tool box from step 12 should be placed separately near the foot step.

| | | |
|--|---|--|
| <p>1 Turntable base</p> <p>Ensure A2 and A3 do not block slots in A1.</p> <p>A2</p> <p>A1 (Inked surface faces down)</p> <p>A3</p> | <p>2 Turntable side walls</p> <p>A28</p> <p>A8</p> | <p>3 Join base and walls</p> <p>Front</p> <p>2</p> <p>1 Flaps go inside assembly 2.</p> <p>Sides marked "Front" must line up.</p> |
| <p>4 Fuselage platform</p> <p>A7</p> <p>Fold to double thickness then cut out shape.</p> <p>A37</p> <p>A9</p> <p>Front</p> <p>Front</p> | <p>5 Join platform to turntable</p> <p>4</p> <p>3</p> <p>Flaps go inside assembly 3.</p> <p>Front</p> <p>Front</p> <p>Sides marked "Front" must line up.</p> | <p>6 Motor mounting rails</p> <p>5</p> <p>Light blue markings at this end, facing upward.</p> <p>A5</p> <p>A4</p> <p>A13 Roll into cylinder</p> |
| <p>7 Motor housing and belt tightener</p> <p>A34</p> <p>A11</p> <p>A10</p> <p>6</p> <p>A6 Attach after motor housing is in place.</p> <p>Slide over rails to cover light blue markings.</p> | <p>8 Spindle</p> <p>7</p> <p>A19 Wrap around top of spindle.</p> <p>A18</p> <p>A17</p> | <p>9 Foot step and lock bars</p> <p>A15</p> <p>A16</p> <p>A29</p> <p>A14</p> <p>8</p> |
| <p>10 Base</p> <p>A20</p> <p>A27</p> <p>A30 Flaps go inside A27.</p> <p>A22</p> <p>A23 4 pieces</p> | <p>11 Base assembly</p> <p>9</p> <p>10</p> <p>Do not glue.</p> | <p>13 Fuselage floor</p> <p>B44</p> <p>B3 (Inked surface faces down)</p> <p>Bend floor as shown before adding other components.</p> <p>Front end (narrow)</p> |
| <p>12 Tool box</p> <p>A26</p> <p>A12</p> <p>A21</p> | <p>14 Control simulators (3 pieces)</p> <p>B29</p> <p>B28</p> | <p>15 Control column base</p> <p>B19 Fold top flaps onto inside surface.</p> <p>B21</p> |

16 Control column assembly

B20 Slide into base.

B32
B30
14

Side view of assembled column.

17 Place controls and rudder pedals

B25 (4 pieces) Fold then cut out shape.

B24 Roll into cylinder

B33
14

B31 Fold then cut out shape.

18 Fuselage front wall

B34
B2 Overhangs B34 on bottom edge only

19 Fuselage front section

B46
B45

Rear edge of B46 lines up with notches in B45. B46 overhangs B45 uniformly on other three sides.

20 Front access panels

B52
19

21 Join wall to front section

Begin gluing at top centre (align red arrows) then wrap down sides.

20
18

Cross section: fuselage skin overlaps front wall.

22 Fuselage centre section

B47
B49
B48

23 Separate door

(omit this step if building model with closed door)

Cut out door (port side).

22

24 Join front and centre sections

Attach first at centre, then wrap down sides.

21
23

Bend assemblies 21 and 23 as closely as possible to this shape before joining for easier assembly.

Bend walls inward at rear to close gap at top of wall.

A38

25 Instrument panel and wall details

B35 Fold then cut out shape.

A25
A24
B22
A24+A25
A32
B36
B23
A31

Starboard wall
Port wall

26 Join floor to fuselage

25
17

Begin at front wall, then work back.

Cross section: fuselage skin overlaps floor.

27 Seat support

Inked side faces up.

B7
B8
B9

Fold then cut out shape.

28 Seat cushion

A36
B6
A35

29 Wheel

B18
Fold around B17

30 Attach seat and wheel

31 Backrest

32 Rear access panels

33 Join backrest to rear fuselage

Attach first at centre, then wrap down sides.
Front edge of fuselage skin is flush with front surface of assy.31.

34 Rear fuselage internal structure

B50
Inked surface faces inside.

B26
Attach to light blue area inside B50 (inked surface faces narrow end). Tilt bottom edge and attach to forward wall of B50.

35 Rear fuselage assembly

36 Attach rear fuselage

37 Fuselage details

38 Port wing internal structure

39 Port wing skin

C56

Fold flap upright.

40 Port aileron and wire bracket

C9

C40

Aileron shape in profile.

41 Starboard wing

C8,13-17,20,40,55

Build as mirror image of port wing.

42 Attach wings to fuselage

90°

Optional:
Add support wire from fuselage to brackets on wings. Use thin (28AWG / 0.32mm) electrical wire or silver thread stiffened with glue.

43 Rudder and hinge posts

C21

C18

C21 overhangs C18 as shown.

C24, C25, C23, C27, C26

44 Rudder assembly

C22

C39
Attach at right angle to rudder surface.

Fit hinge posts into slots in rudder then attach C22.

Bend overhanging edges of rudder skin to form rounded edge.

45 Elevators

C28 C29 C30 C31 C32 C33 C34

Assemble in similar manner to rudder assembly.

46 Attach elevator assembly to fuselage

Centre crossbar as indicated by red marking.

C36 C37 C38

Edges of horizontal stabilizers do not touch fuselage sides.

47 Attach rudder

44 46

48 Canopy walls

Outside (yellow) surfaces shown facing down.

C1 C2 C3 C4 C41 C42 C43 C44

C3/C43, line up bottom edge when joining. Other outside parts (C1,2,4) overhang inside parts slightly on all sides.

C3+C43 C2+C42 C4+C44 C1+C41 C5

C5 Fold then cut out shape.

Top view (full scale).

49 Canopy roof

C35 Shown facing down C45 C46 C47 C48

Bend roof into curve (yellow side outward) to close gaps between segments.

Attach ribs to inside of roof.

C52 C53 C54

50 Canopy assembly

C10 C11 C6 B10 C7 C10+C11

51 Door assembly

Bend door to match fuselage contours.

B40 B41 B42 B43 B5

Door cutout from step 23.

52 Lamps

B37 B38 B39 B42 B43 (2 pieces)

B37+B39 B42+B43 B38+B39

53 Attach canopy

50 52

54 Figure and final assembly

C50 C51 11 12

Place tool box near base (acts as step for pilot).