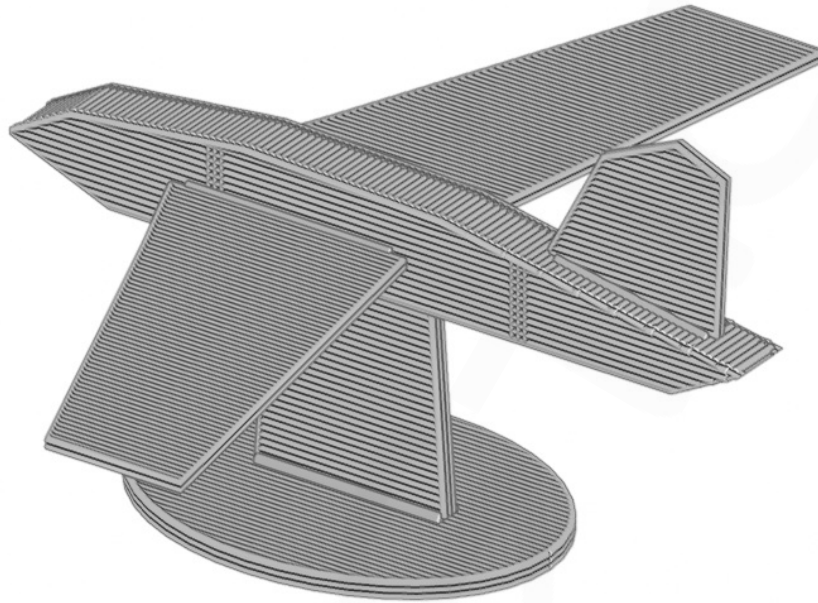


MAKE • DISCOVER • COLLECT

Airplane on a Stand

Beginners aged 10 and up, teenagers, and adults. • About 50–80 minutes, at your own pace



Build a three-dimensional PLA display airplane: a filled fuselage made from two profiles, horizontal wings, a vertical tail, and a rigid stand. Choosing your own colors and comparing both sides help you practise symmetry.



Your outcome

Learn to position parts symmetrically in three dimensions.

Construction illustration. The instructions show the successive stages. Full-size (1:1) templates are supplied on a separate sheet.

What you need

Additional items are needed. Prepare the complete list below before starting.

Equipment

- | | |
|--|-------|
| ☐ 3D pen suitable for PLA | 1 pc. |
|--|-------|

Materials

- | | |
|---|-------|
| ☐ PLA filament in your chosen colors | 1 set |
|---|-------|

Equipment

- | | |
|--|-------|
| ☐ Clear, flat work surface suitable for PLA | 1 pc. |
| ☐ Printed 1:1 templates | 1 set |
| ☐ Ruler with millimeter markings | 1 pc. |
| ☐ Regular paper scissors for separating the template panels | 1 pc. |

Filament — amounts include extra

- | | |
|---|------------------|
| ☐ PLA 1.75 mm — colour shown in the illustration | 5.2 m · ≈ 15.6 g |
| ☐ PLA 1.75 mm — colour shown in the illustration | 0.2 m · ≈ 0.6 g |
| ☐ PLA 1.75 mm — colour shown in the illustration | 4.7 m · ≈ 14.1 g |
| ☐ PLA 1.75 mm — colour shown in the illustration | 6.6 m · ≈ 19.8 g |
| ☐ PLA 1.75 mm — colour shown in the illustration | 0.4 m · ≈ 1.2 g |

Total filament: 17.1 m · approximately 51.3 g

The quantities include extra filament. Grams indicate estimated net filament mass, excluding packaging.

Before you start

Help with joining

During welding, a second person should stabilize only the cool ends indicated on the card. Agree on the grip before turning on the pen.

Your choice of colors

The colors in the illustrations are examples. Choose your own PLA and repeat the pattern on both sides; the number of layers and the contact points remain the same.

- 1 Print all templates at 100% scale, without fitting them to the page. Before using the pen, check the control segment with a ruler: it must be exactly 20 mm.
- 2 Place the work surface securely, flat, and entirely on the tabletop, away from the table edge. Leave a clear area of at least 15 × 12 cm beneath it and a 32 × 16 cm area beside it for cool parts; clear at least 20 × 20 cm for assembly.
- 3 Place only one paper template at a time under the work surface, centered in the clear area: the fuselage profile with its nose pointing left—use it twice; then the frame with its long line running left to right.

In the next stage, position the wing with its straight root toward you—use it twice; then position the stabilizer with its sloping base toward you. Finally, position the base with its longer axis running left to right, then the support with its wider foot toward you.

- 4 If the templates are on several pages, use regular paper scissors to cut a rectangle around each panel, leaving a margin of at least 5 mm beyond the lines. Do not cut the PLA shapes out of the paper.

Place each new template only after the previous part has cooled and been moved to the clear area and the previous sheet of paper has been removed completely. Do not overlap the templates.

- 5 Choose your own PLA colors: you can repeat stripes on both sides. Adjust the pen settings according to its instructions and the PLA. Before assembly, arrange for someone to help by holding the cool ends of the parts. Do not touch the nozzle or fresh welds.

A project estimate for home or workshop use, with no lesson time limit. It includes preparation, 30–50 minutes of pen work, cooling, assisted assembly, checking, and cleanup. The time was not measured in a physical trial.



How to read the instructions

The large image shows the completed stage. Small views show the action and current parts. ×N means repeat the whole action N times, cooling and checking each time. Illustrations are not at 1:1 scale.

STAGE 01 / 08 • Session pracownia

Two sides and a frame



Two profiles

Frame with crossbars

NOW Left fuselage profile · Right fuselage profile · Frame with two crossbars

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Left fuselage profile; 1 × Right fuselage profile · PLA | template profil

1 × Frame with two crossbars · PLA | template poprzeczki

→ T001, T002 • Techniques — reference appendix

After preparing the templates, make two fuselage profiles in sequence: trace the outline and thickened marks, each in 2 layers. Leave the areas empty. Then make one frame: join two crossbars of 4 adjacent strands each with a long double line and repeat the second layer.

Cool each part for 30–60 s until rigid before clearing the area for the next template.



Check

Two identical profiles and one joined frame, 3 parts in total.

If it does not work

Fill gaps with PLA while flat, then cool again.

STAGE 02 / 08 • Session pracownia

Build the three-dimensional fuselage



Second side and complete frame

Frame with the first side

NOW Left fuselage profile · Frame with two crossbars · Frame welds—left side · Right fuselage profile · Frame welds—right side

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Frame welds—left side; 1 × Frame welds—right side · PLA | template follow the written method

→ T003 • Techniques — reference appendix

Lay the left profile flat. Position the frame perpendicular to it: both ends of the crossbars touch the thickened marks halfway up the profile. The helper holds the cool end of the frame. Add short welds on both sides of both joints. Let them cool.

Place the second profile on the free ends of the crossbars, with its nose pointing in the same direction. The helper holds its cool ends; join and cool it in the same way.



Check

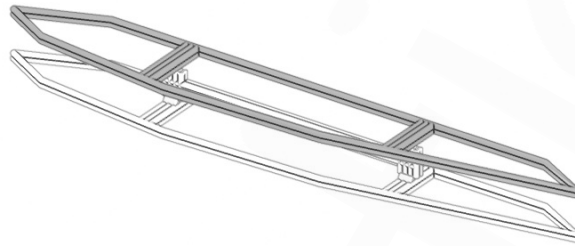
Profiles parallel, outer width about 10 mm; both ends aligned and the frame rigid.

If it does not work

Correct the position before welding. Support a loose joint, add PLA, and let it cool.

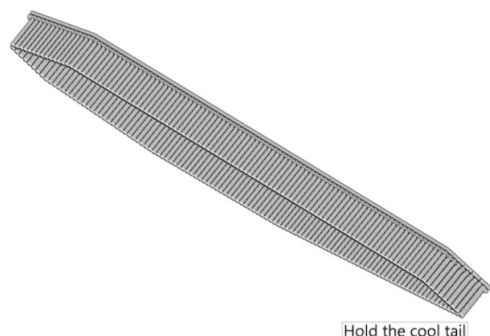
Build the three-dimensional fuselage — construction details

The second profile closes the width



STAGE 03 / 08 • Session pracownia

Fill and close the fuselage



First solid side



Second side with the same pattern

Closed underside

NOW Right fuselage profile · Left fuselage profile

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

Fill the upper side with adjacent lines from outline to outline, in 2 layers. Let it cool and turn the fuselage onto the solid side; fill the other side in the same way. Place the cool fuselage with its underside down. Close the spine with short bridges across the 8 mm width: each one joins both sides and the previous strand.

Work from nose to tail, waiting a few seconds between strands. Let it cool, turn it over, and close the underside in the same way while the helper holds the cool nose and tail. Choose colors for the skin.



Check

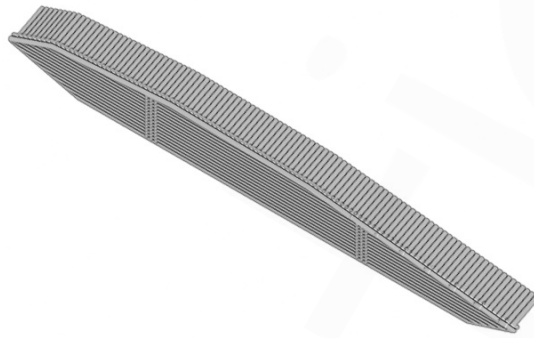
Solid sides, spine, and underside form a rigid, narrow solid; the central underside is straight.

If it does not work

If a strand sags, stop and let it cool. Rest the next segment on both rigid edges and the previous line.

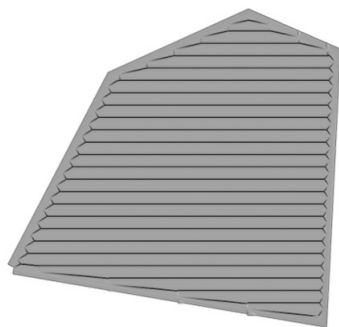
Fill and close the fuselage — construction details

Both sides and the spine



STAGE 04 / 08 • Session pracownia

Your own wing and tail colors



Wing outlines

Roots first

Stabilizer

NOW Left wing · Right wing · Vertical stabilizer

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Left wing; 1 × Right wing · PLA | template skrzydło

1 × Vertical stabilizer · PLA | template ogon

→ T004, T005 • Techniques — reference appendix

Make two identical wings in sequence: trace the outline in 2 layers, then add adjacent fill lines in both layers, for a total thickness of about 2 mm. Start with the half by the straight root, then fill the tip. Repeat your chosen color pattern.

Make the stabilizer with its sloping base: trace the outline and fill it completely, also in 2 layers. Cool the parts flat until rigid.



Check

Two identical solid wings and one solid stabilizer, with no warping or loose strands.

If it does not work

Fill the gap while the part is flat. Do not bend soft or cool parts.

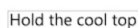
Your own wing and tail colors — construction details

Solid wings



STAGE 05 / 08 • Session pracownia

Wings level, tail vertical

Hold the cool topPosition the left wingSupport the cool wing

Left root

Vertical tail

NOW Left wing · Root welds—left wing · Right wing · Root welds—right wing · Vertical stabilizer · Stabilizer welds

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Root welds—left wing; 1 × Root welds—right wing · PLA | template follow the written method

1 × Stabilizer welds · PLA | template follow the written method

→ T006, T007 • Techniques — reference appendix

Rest the fuselage on its underside. Position the left root horizontally, 6 mm above the fuselage's lower line, with its front 25 mm behind the nose. The helper holds the cool end of the wing. Add tacks at the front and back, let them cool, then connect them with a 31 mm weld above and below the root.

Rotate the entire cool assembly to reach the underside. Attach the right wing in the same way, at the same height and distance from the nose. Position the tail's sloping base in the center of the spine; the helper holds the cool top vertically. Add welds on both sides. Cool every joint while supported.



Check

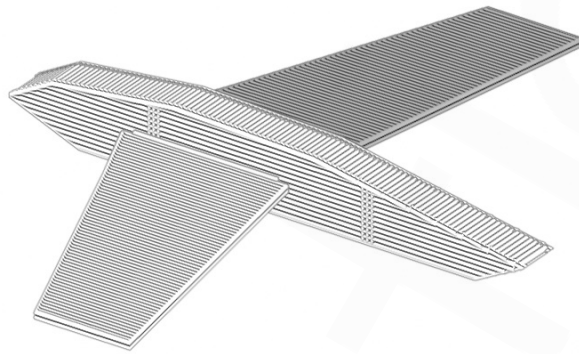
The wings are at the same height and extend equally; the stabilizer is vertical and all joints remain still.

If it does not work

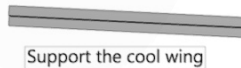
Compare the alignment before welding. Support loose joints and add material. Do not force a permanently crooked joint straight.

Wings level, tail vertical — construction details

Position the right wing symmetrically

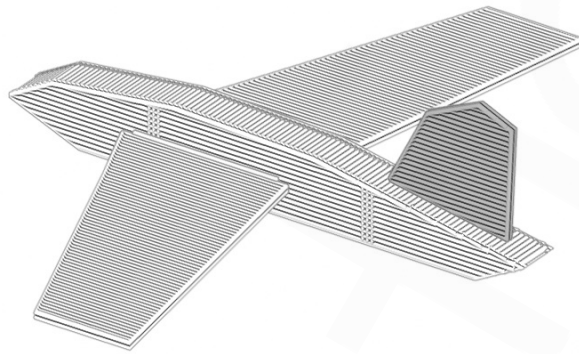


Right root



Wings level, tail vertical — construction details

Position the stabilizer vertically



STAGE 06 / 08 • Session pracownia

Build the rigid stand

Hold the cool top



Start the base



Two solid parts

Assembled stand

NOW Stand base • Short support • Support-foot welds

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Stand base • PLA | template podstawa

1 × Short support • PLA | template wspornik

1 × Support-foot welds • PLA | template follow the written method

→ T008, T009, T010 • Techniques — reference appendix

Set the cool airplane aside. Make the base and support in sequence: trace the outline and fill tightly with adjacent lines, each in 3 layers of about 1 mm. Cool them flat. Position the support vertically in the center of the oval, with its wider foot along the long axis.

The helper holds the cool top; add a 28 mm weld on each side of the foot. Rotate the base to reach the other side. Cool until rigid.



Check

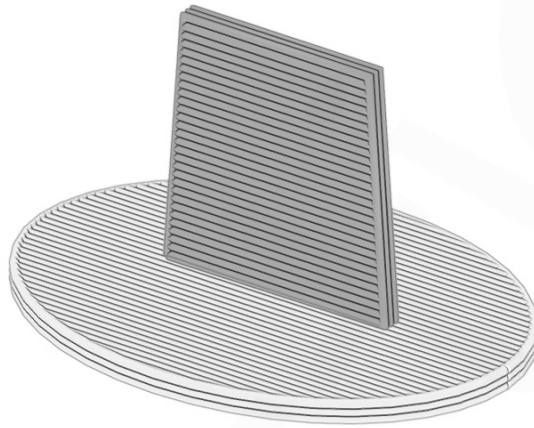
Base flat; the stand remains upright by itself, and the support does not wobble.

If it does not work

Hold it vertically, add material to the loose weld, and cool it again.

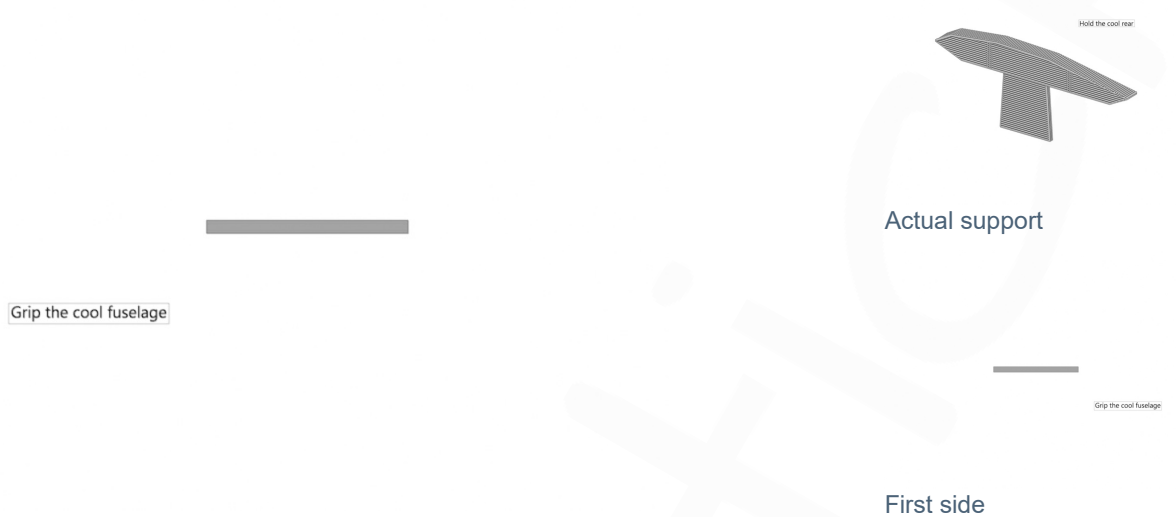
Build the rigid stand — construction details

Stand the support in the center



STAGE 07 / 08 • Session pracownia

Mount the airplane on the stand



Grip the cool fuselage

Actual support

First side

Second side

NOW Left fuselage profile · Short support · Fuselage welds on the support

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

PARTS FOR THIS STAGE

1 × Fuselage welds on the support · PLA | template follow the written method

→ T011 • Techniques — reference appendix

Place the stand flat. Rest the central underside of the fuselage along the entire top edge of the support: on the fuselage centerline, beneath the wing roots. The helper holds the cool nose and rear, keeping the wings level. From the side, below the wings, add a 24 mm weld joining the underside to the support. Let it cool while held.

Move to the other side and add the second weld. Wait until both welds are fully rigid; only then release slowly.



Check

The fuselage rests on the support and the base is flat; after release, the airplane does not tilt.

If it does not work

Do not release your grip while the weld is soft. Support a loose joint, add PLA, and let it cool.

STAGE 08 / 08 • Session pracownia

Check and display



Front check

NOW Complete model — all previously made parts

Blue / dark emphasis: the part used in this action. Arrows: visual guides. Illustration not to scale.

On a level tabletop, remove your hands for 10 seconds. Use a ruler to compare the heights of both wingtips above the tabletop; they should be equal. Look from above and compare how far they extend on both sides of the fuselage. Check that the tail is vertical and the welds remain still. Choose a place for your display model.

Do not throw it or try to fly it.



Check

The model stands by itself, the wings are symmetrical, and the tail is vertical; nothing wobbles.

If it does not work

Support a loose part while adding material to the weld. If a joint is permanently crooked, stop and ask for help; do not bend the PLA.

Finished — check the outcome



Check

The airplane has two spatially connected fuselage sides, solid surfaces, horizontal wings, and a vertical stabilizer.



Check

Corresponding wingtips are at the same height and extend by similar amounts.



Check

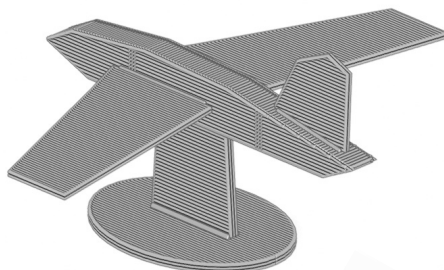
The cool model stands on its base by itself for 10 seconds; the joints remain still.

Storage

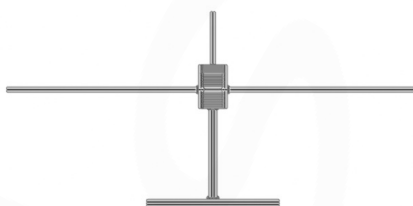
Store the model in a cool place away from sunlight and heat. Repair it on a suitable 3D-pen work surface using the same material as the part.

View from different sides

View 1



View 2



Techniques — reference appendix

T001 • Stage 1

1 × Left fuselage profile; 1 × Right fuselage profile · PLA | template profil

Trace the template and three adjacent strands along each of the two crosswise marks. Repeat after cooling: 2 layers, each about 1 mm. Leave the areas empty for assembly. Later, fill them with adjacent lines from outline to outline, without gaps, in both layers. Number of layers: 2.

Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

T002 • Stage 1

1 × Frame with two crossbars · PLA | template poprzeczki

Make two crossbars with 4 adjacent strands each and join them with two long strands as shown on the template. Repeat the entire arrangement in the second layer. All intersections should fuse together; after cooling, the frame is one piece. Number of layers: 2.

Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

T003 • Stage 2

1 × Frame welds—left side; 1 × Frame welds—right side · PLA | template follow the written method

At each of the two points where a crossbar meets the profile, add a short PLA strand on both accessible sides of the joint. Each strand should grip both parts. Finished cross-section [mm]: 1.4 × 1.4. Support: The first profile lies flat; the helper holds the cool end of the frame or upper profile.

Strand direction: At each of the two points where a crossbar meets the profile, add a short PLA strand on both accessible sides of the joint. Each strand should grip both parts. Cooling: Hold still for 30–60 s, until the weld is fully rigid. Allow more time if the PLA is soft.

Tip access: Approach with the nozzle from the open side of the frame; keep fingers on the cool nose and tail end, away from the welds.

T004 • Stage 4

1 × Left wing; 1 × Right wing · PLA | template skrzydlo

Trace the template in 2 layers of about 1 mm each. In each layer, fill with adjacent lines from edge to edge: first the half by the root, then the tip. Each line touches the previous one. Repeat your chosen color arrangement on the other wing. Number of layers: 2.

Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

T005 • Stage 4

1 × Vertical stabilizer · PLA | template ogon

Trace the template and fill it tightly with adjacent lines in 2 layers of about 1 mm each. The sloping lower edge fits against the fuselage spine. Wait until the stabilizer is cool and rigid. Number of layers: 2. Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

Techniques — reference appendix — continued

T006 • Stage 5

1 × Root welds—left wing; 1 × Root welds—right wing · PLA | template follow the written method

Hold the wing root 6 mm above the lower fuselage line. Join the root to the side with a continuous 31 mm weld above and below the wing; begin with short tacks at the front and back, cool them, then connect them. Finished cross-section [mm]: 1.4 × 1.4. Support: The fuselage rests on its cool underside.

The helper holds the cool outer end of the wing level; after the first weld, you can rotate the entire cool assembly to reach the underside. Strand direction: Hold the wing root 6 mm above the lower fuselage line.

Join the root to the side with a continuous 31 mm weld above and below the wing; begin with short tacks at the front and back, cool them, then connect them. Cooling: Hold still for 30–60 s, until the weld is fully rigid. Allow more time if the PLA is soft.

Tip access: Run the nozzle along the root from above, then below; keep your grip at least 20 mm from the hot weld.

T007 • Stage 5

1 × Stabilizer welds · PLA | template follow the written method

Position the stabilizer's sloping base in the center of the spine. Add one 23 mm weld along each side of its lower edge. Finished cross-section [mm]: 1.4 × 1.4. Support: Keep the fuselage on its cool underside; the helper holds the cool upper end of the stabilizer vertically.

Strand direction: Position the stabilizer's sloping base in the center of the spine. Add one 23 mm weld along each side of its lower edge. Cooling: Hold still for 30–60 s, until the weld is fully rigid. Allow more time if the PLA is soft.

Tip access: Approach with the nozzle from the left and right sides; keep fingers at the top of the stabilizer.

T008 • Stage 6

1 × Stand base · PLA | template podstawa

Trace and fill the oval in 3 layers of about 1 mm each. Place the lines next to one another; each one joins both edges and the previous line. Cool the base flat. Number of layers: 3. Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

Techniques — reference appendix — continued

T009 • Stage 6

1 × Short support · PLA | template wspornik

Trace and tightly fill the template in 3 layers of about 1 mm each. The support remains flat and rigid. The wider 28 mm edge is the foot, and the upper 24 mm edge supports the fuselage; do not bend the PLA. Number of layers: 3. Cooling: Cool until rigid before moving; this usually takes 30–60 s, or longer if the PLA is still soft.

T010 • Stage 6

1 × Support-foot welds · PLA | template follow the written method

Place the wider end of the support at the center of the base, along its longer axis. Add a continuous 28 mm weld on both sides of the foot. Finished cross-section [mm]: 1.4 × 1.4. Support: Keep the base flat on the tabletop; the helper holds the cool top of the support vertically.

Strand direction: Place the wider end of the support at the center of the base, along its longer axis. Add a continuous 28 mm weld on both sides of the foot. Cooling: Hold still for 30–60 s, until the weld is fully rigid. Allow more time if the PLA is soft.

Tip access: Approach with the nozzle from both sides of the foot; rotate the cool base instead of reaching across the pen.

T011 • Stage 7

1 × Fuselage welds on the support · PLA | template follow the written method

Join the fuselage underside to the top of the support with a 24 mm weld on the first side. Cool it while supported, then add a weld on the other side. Finished cross-section [mm]: 1.4 × 1.4. Support: Keep the base flat.

The top of the support touches the underside of the fuselage; the helper holds the cool nose and rear of the fuselage, keeping the wings level. Strand direction: Join the fuselage underside to the top of the support with a 24 mm weld on the first side. Cool it while supported, then add a weld on the other side.

Cooling: Hold still for 30–60 s, until the weld is fully rigid. Allow more time if the PLA is soft. Tip access: Approach with the nozzle from the side, below the wings; keep fingers on the nose and near the tail, away from the welds.