Howard DGA-5 “IKE”

a *“**D**amned **G**ood **A**irplane”*

User Guide for Version 2.2

Figure 1: 3D printed Howard DGA-5 “IKE”

Scale:	1 : 6.1
Length:	850 mm (33.5 in)
Wingspan:	1000 mm (39.4 in)
Wing airfoil:	NACA0012 -> NACA0009
Tail airfoil:	NACA0003
Empty weight:	[575…635] g ([20.3…22.4] oz)
Takeoff weight:	[855…995] g ([30.2…35.1] oz)
Wing area:	16 dm^2 (248 in^2)
Wing load:	[53…62] g/dm^2 ([17.5…20.3] oz/ft^2)
Channels:	5

Content:

Content: 1
The original 2
What you need 3

3D printer specification 3
Required materials 3
Radio control components 4
What you get 4
3D print files 4
Ultimaker Cura slicer settings 10
Decal sheets 15
Assembly 15
Step by step video guide 15
Noteworthy changes in assembly for version 2.1 16
Noteworthy changes in assembly for version 2 16
Pre-flight setting & check 19
Change log 21

The original

The Howard DGA-5 *“IKE”* evolved from one of two almost identical prize-winning racers *“MIKE”* and *“IKE”* developed by Benny Howard in 1932 [1]. From 1932 to 1936 both planes won plenty of racing prices culminating in 1935 when Howard aircraft won the Bendix, Thomson, and Greve Throphy – a season of racing events that became unofficially known as *“Benny Howard National Air Races”* [2].

Figure 2: Harold Neumann with Miss Chevrolet in Miami, Florida. “Ike” (NR56Y) was sponsored by the Chevrolet Division of General Motors and was therefore also known as “Miss Chevrolet” [3].

What you need

3D printer specification

All STL files have been successfully tested with my Prusa i3 MK3S.

3D print volume	Minimum requirement for single STL file (ensures printability of all plane parts): X=190mm; Y=180mm; Z=171mm Optional files (STL, project, gcode) are provided to print the most inner wing parts with such small printer bed sizes (see optional print parts below). Minimum requirement for other gcode: X≅240mm; Y≅200mm; Z=171mm
Nozzle diameter	0.4mm
Filament support	PLA, TPU, (PETG)

Required materials

All basic plane parts are printable except for a few components such as steel wires or nylon screws.

Filament	White **PLA** for majority of print parts: ~625g (e.g., FormFutura Premium PLA Frosty White) Black **PLA** for exhaust pipes: ~2g (or paint a white PLA print with black color) Transparent **PETG or PLA** for the wind shield: ~2g (e.g., FormFutura Hdglass Clear) Black **TPU** for tires: ~15g, (e.g., 3D WarHorse TPU Black) Optionally, white LW-PLA for horizontal stabilizers, rudders, ailerons, and wing servo covers: ~55g (e.g., colorFabb LW-PLA NATURAL)
Spring steel wires	Ø 1.5mm, 1pc of length ~930mm (main landing gear) Ø 1.0mm, 1pc of length ~70mm (tail landing gear) Ø 1.0mm, 2pcs of length ~800mm (pushrods)
Linkage stopper	2pcs for pushrods e.g., Hobbyking Brass Linkage Stopper For 1mm Pushrods
Screw-in nuts	2pcs M4x10 (outer Ø ≤8.0mm, sometimes used for furniture)
Self-tapping screws	8pcs M2.3x6 for wing servo cover 8pcs M2.3x6 for servo holder (optional)
Nylon screws	2pcs M4x20mm
CA hinge sheet	1pc e.g., Hobbyking CA Hinge Sheet 180mmx140mmx0.3mm
Elastic cord	Ø 1.0mm, grey or white ("flying wires", I am using grey color)
Carbon fiber rod	Optional: Ø 2.0mm, 1pc of length 250mm. Intended as alternative for the tail flying wires if LW-PLA is used.
Carbon fiber pipe	Optional: Outer Ø 6.0mm, inner Ø 4.0mm, 1pc of length 700mm. Intended as reinforcement of the wing to support cunning aerobatic figures.
CA glue	Medium viscosity e.g., Hobbyking Super Glue CA (50g / 1.7oz) Medium
CA accelerator	Recommended e.g., Hobbyking Insta-Set CA Accelerator 2. Oz

Double-sided tape	Strong sticky tape to fix the receiver and optionally the servos to the airplane e.g., Hobbyking Double Sided Tape (Clear) 25mm x 1m
Decal sheet	2pcs A4 or letter format (e.g., inkjet waterslide decal paper)
Clear spray coating	~200ml, for decal sheets (e.g., acrylic clear finish)

Radio control components

There is a huge variety of products available on the market that fulfills the requirements to provide enough power and precise control for the Howard DGA-5 “IKE”. The following set is what I am currently using and can recommend. It The power system provides a maximum thrust to weight ratio of 1.2 and a mixed flight time of more than 7 minutes.

Motor	Hobbyking PROPDRIVE v2 2836 1200KV (max. Ø 32mm)
ESC	Hobbyking Turnigy Plush-32 30A (2~4S) Brushless Speed Controller W/BEC
Battery	Hacker TopFuel LiPo 25C ECO-X 1800mAh 3S MTAG
Propeller	Hobbyking Meister Airscrew Propeller 9x6inch
Servos (4pc)	Hobbyking Corona DS-843MG
RC control	5 channel TX/RX

What you get

3D print files

In addition to the complete set of STL files, the package includes a set of Ultimaker Cura project files and the hereof generated gcode. Cura is a powerful open-source software that can be downloaded for free. The project files (and the gcode) were created with version 4.9.1 and contain all detailed information required to also print each airplane part on its own.

STL	STL stands for Standard Tessellation Language, a file format that describes the surface geometry of a three-dimensional object. The package includes STL files for all printable parts of the airplane including a bending template to form the spring steel wires of the landing gear. Moreover, for some parts modified STL files are provided for optional printing with Low-Weight-PLA.
Project files	Multiple STL files can be combined into a single project file (.3mf) and “print job” (.gcode). Even more important, specific slicer settings can be applied to each part e.g., to increase stability of a certain part area or consider support for part areas with large overhang angle. The package includes 16 project files (6 are optional) which offer full access to all specific slicer settings used for each plane part. All project files can be easily modified with the graphical user interface of Cura to comply with the print volume and other unique parameters of your 3D printer.
Gcode	For each project file and each LW-PLA printable part corresponding gcode files are provided to minimize your preparation time. Please note that these gcode files are optimized for the Prusa i3 MK3S. For many 3D printers and filaments, the gcode should work out of the box. If you

experience issues with the print quality, I recommend having a closer look at the slicer parameters listed below to optimize the gcode for your printer.

Figure 3 depicts an exploded view of the Howard DGA-5 “IKE”. Together with the following part list it provides an overview of all 3D printable parts. The color code of the index numbers visualizes to which project file and gcode the parts belong.

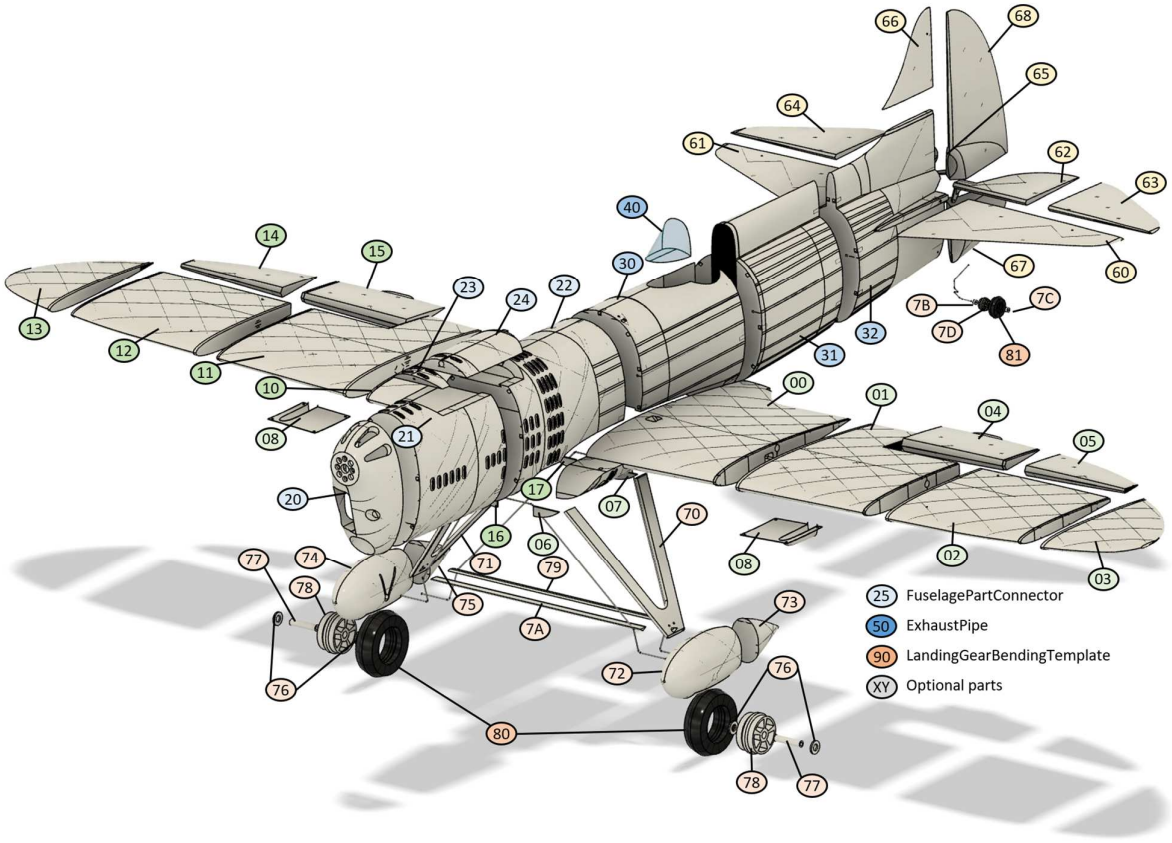
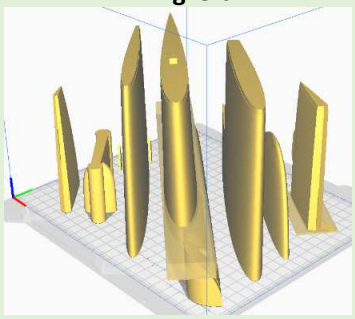
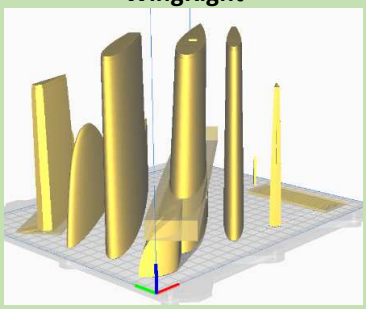
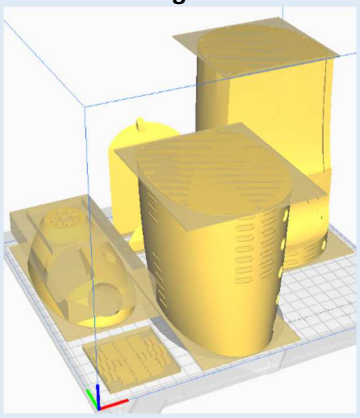
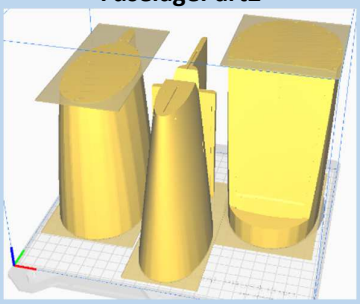
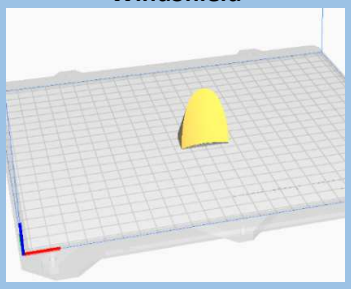
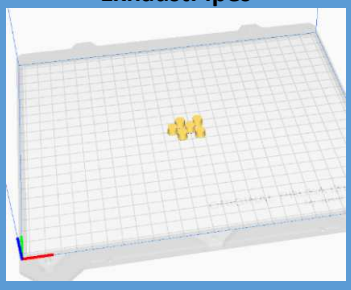
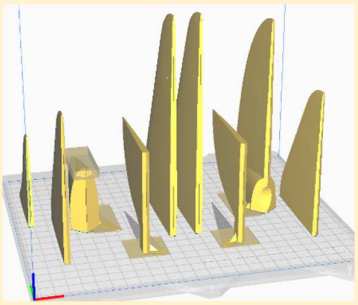
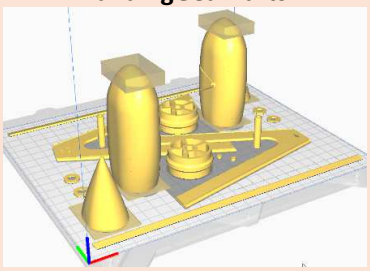
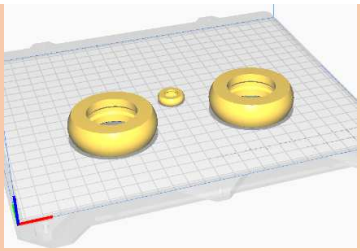
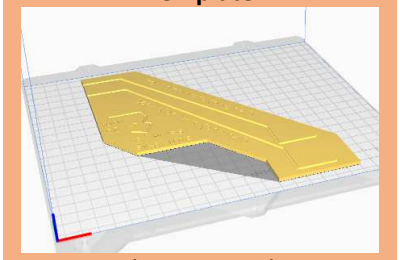
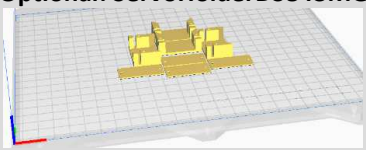
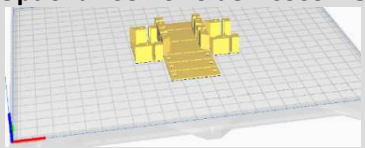
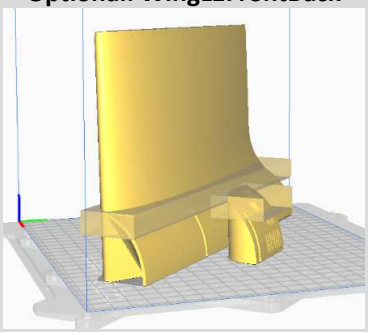


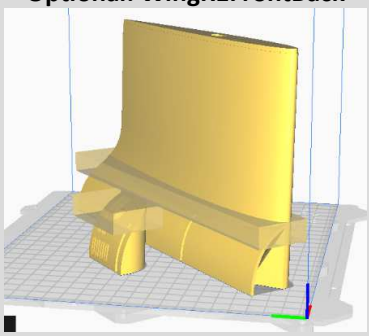
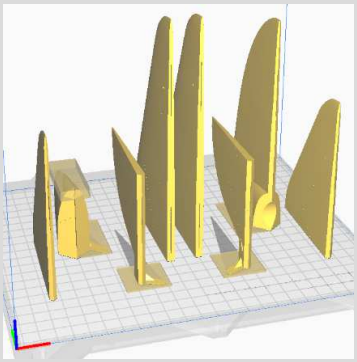
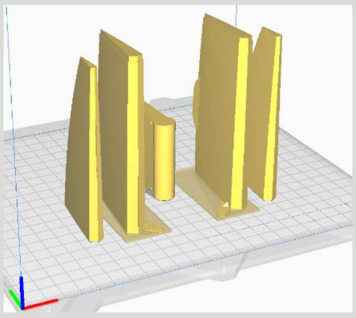
Figure 3: Exploded view with labeled plane parts

Project (.3mf/.gcode)	Part name (.stl)	Idx	Print weight	Setting
WingLeft  time: 27h 31m, weight: 148g	Wing1L	00	56 g	Modified
	Wing2L	01	33 g	Default
	Wing3L	02	27 g	Default
	Wing4L	03	12 g	Default
	Aileron1L	04	10 g	Modified
	Aileron2L	05	5 g	Default
	LandingGearShimFrontL	06	< 1 g	Default
	LandingGearShimBackL	07	< 1 g	Default
	ServoCover (left+right)	08	5 g	Default

WingRight  time: 26h 59min, weight: 144g	Wing1R Wing2R Wing3R Wing4R Aileron1R Aileron2R LandingGearShimFrintR LandingGearShimBackR SpacerFlyingWires	10 11 12 13 14 15 16 17 18	56 g 33 g 27 g 12 g 10 g 5 g < 1 g < 1 g 1 g	Modified Default Default Default Modified Default Default Default Modified
FuselagePart1  time: 20h 35m, weight: 113g	Fuselage1 Fuselage2 Fuselage3 CanopyFront CanopyBack FuselagePartConnector (45pcs)	20 21 22 23 24 25	25 g 39 g 40 g 6 g 2 g 1 g	Modified Modified Modified Modified Modified Modified
FuselagePart2  time: 16h 20m, weight: 95g	Fuselage4 Fuselage5 Fuselage6	31 32 32	34 g 28 g 31 g	Modified Modified Modified

WindShield  time: 0h 18m, weight: 1g	WindShield	40	1 g	Modified
ExhaustPipes  time: 0h 5m, weight: 0g	ExhaustPipe (6pcs)	50	< 1 g	Modified
Tail  time: 12h 0m, weight: 70g	HorizontalStabilizerL HorizontalStabilizerR ElevatorL1 ElevatorL2 ElevatorR1 ElevatorR2 VerticalStabilizer RudderBottom RudderTop	60 61 62 63 64 65 66 67 68	13 g 13 g 5 g 6 g 5 g 6 g 3 g 6 g 11 g	Default Default Modified Default Modified Default Default Modified Modified
LandingGearParts  time: 9h 21m, weight: 51g	LegL LegR WheelPantFrontL WheelPantBackL WheelPantFrontR WheelPantBackR WasherMainWheel (4pcs) AxleMainWheel (2pcs) RimMainWheel (2pcs) CrossbarTop CrossbarBottom WasherTailWheelL WasherTailWheelR RimTailWheel	70 71 72 73 74 75 76 77 78 79 7A 7B 7C 7D	8 g 8 g 9 g 2 g 9 g 2 g < 1 g < 1 g 8 g < 1 g < 1 g < 1 g < 1 g < 1 g	Modified Modified Modified Modified Modified Modified Modified Modified Modified Modified Modified Modified Modified Modified
Tires	TireMainWheel (2pcs) TireTailWheel	80 81	20 g 1 g	Modified Modified

 time: 4h 08m, weight: 20g				
LandingGearBending Template  time: 3h 45m, weight: 20g	LandingGearBendingTemplate	90	20 g	Modified
Optional: ServoHolderDS843MG  time: 1h 53m, weight: 9g	ServoHolderDS843MG (4pcs)	A0	9 g	Modified
Optional: ServoHolderDS939MG  time: 1h 56m, weight: 9g	ServoHolderDS939MG (4pcs)	B0	9 g	Modified
Optional: WingL1FrontBack  time: 10h 48m, weight: 58g	WingL1Front WingL1Back	010 011	5 g 53 g	Modified Modified

Optional: WingR1FrontBack  time: 10h 48m, weight: 58g	WingR1Front WingR1Back	100 101	5 g 53 g	Modified Modified
Tail LW-PLA  weight: 34g Print each part separately!	HorizontalStabilizerL HorizontalStabilizerR ElevatorL1 ElevatorL2 ElevatorR1 ElevatorR2 RudderBottom RudderTop	600 610 620 630 640 650 670 680	6 g 6 g 3 g 3 g 3 g 3 g 3 g 6 g	Default Default Modified Default Modified Default Modified Modified
Ailerons & Servo Cover  weight: 17g Print each part separately!	Aileron1L Aileron2L Aileron1R Aileron2R ServoCover (left+right)	040 050 140 150 080	5 g 3 g 5 g 3 g 3 g	Modified Default Default Default Default

Note: If you want to use a different slicer software, please make sure to check and reapply all part-dependent print settings provided in the cura project files. Otherwise, some parts may not print as expected!

Figure 4: All printed parts at a glance

Ultimaker Cura slicer settings

A correct setting of the slicer parameters is essential to achieve excellent surface quality and layer adhesion. The following list shall help to get a better insight and to find the best Cura settings for your printer. Note that all modified settings used in the project files were derived from these default settings.

Cura slicer parameter		Default setting	Remarks
Quality	**Layer Height**	0.2mm	All parts can be printed with this default value. A smaller value (≥0.1mm) typically improves the surface quality and allows to print larger overhang angles without support. Print duration increases though.
	Initial Layer Height	0.2mm	Slightly increasing this value may improve first layer adhesion. If you experience first layer adhesion issues 1. Make sure that your printer is well calibrated. 2. Use 3DLac to avoid insufficient (PLA, ASA, etc.) or too strong (TPU) layer adhesion.

Walls	**Wall Thickness**	0.4mm	The plane is designed for 0.4mm wall thickness. Smaller values may lead to insufficient adhesion between the perimeter and inner structures. Larger values increase weight and are hence not recommended.
	Optimize Wall Printing Order	Off	Make sure to print the outer wall first to obtain a smooth surface. Without this setting, inner structures may appear as bumps on the outer surface.
	Outer Before Inner Walls	On	
	Compensate Outer/Inner Wall Overlaps	On	This setting also helps to avoid bumps.
	Filter Out Tiny Gaps	On	This function seems to have negligible impact on the print quality.
	Print Thin Walls	Off	I recommend turning off this setting to save print time and slightly reduce the weight of the printed part.
	Z Seam Alignment	User Specified	Layer changes are always causing small blobs or gaps due to pressure fluctuations in the nozzle. I've tried to minimize its visibility for all prints by selecting suitable values for X and Y e.g., by selecting less visible areas or sharp corners.
	Z Seam X	Values are roughly optimized for each part (see project files).	
	Z Seam Y		
	Seam Corner Preference	Smart Hiding	This setting may help to minimize the visibility of layer changes.
Top/Bottom	**Top/Bottom Thickness**	0.0mm	Top/bottom layers are not needed for most plane parts.
Infill	**Infill density**	0%	Infill is not needed for most plane parts.
Material	**Printing Temperature**	220°C	This value is at the upper limit for PLA to maximize layer adhesion. Anyway, if you experience stringing issues, feel free to reduce this value by a few degrees. For PLA, I recommend using at least 210°C. TPU and PETG require higher temperatures of around 240-250°C.
	Build Plate Temperature	50°C	Do not go above 50°C for PLA. Otherwise, a deformation of the thin

			wall print may occur in the first ~30 layers. Use 0°C for TPU to avoid too strong first layer adhesion.
	Built Plate Temperature Initial Layer	60°C	If you experience first layer adhesion issues with PLA, please refer to my remarks on "Initial Layer Height" instead of increasing the build plate temperature above 60°C. Use 0°C for TPU to avoid too strong first layer adhesion.
	Flow	100%	This default value is typically fine. In rare cases, your printer might require a slightly different setting.
Speed	**Print Speed**	30mm/s	These settings are rather on the conservative side (slower typically results in better print quality) to ensure nice print and surface quality. Same setting can be used for PLA, PETG and TPU.
	Outer Wall Speed	20mm/s	
	Travel Speed	120mm/s	
	Initial Layer Speed	15mm/s	
Travel	**Enable Retraction**	On	Reduces stringing.
	Retract at Layer Change	On	Helps to mitigate blobs and gaps at layer change.
	Retraction distance	0.8mm	This value strongly depends on the type of extruder used with the printer. The default value is suitable for direct extruders (e.g., Prusa i3 MK3S). Bowden extruders typically require larger values up to a few mm.
	Retraction Speed	35mm/s	This is the default Cura slicer value that works fine with my printer.
	Retraction Extra Prime Amount	0.02mm^3	During travel some material oozes out of the nozzle. This value allows to compensate for it. You may adjust it according to your printer and filament requirements.
	Retraction Minimum Travel	0.8mm	This value avoids too many retractions when printing very detailed areas.
	Combing Mode	Off	Very important setting to achieve good thin wall print quality. Please note that this setting is enabled by default in many Cura profiles.

	Z Hop When Retracted	On	Important setting to obtain nice print results. Without retract the nozzle may damage the printed part during travel moves.
	Z Hop Height	1.0mm	Typical and useful value.
Cooling	**Enable Print Cooling**	On	By default, these settings use 0% cooling. Only in case of single layer print duration below 7 seconds 50% cooling is applied. These settings yield very good layer adhesion and minimum deformation of the thin walls with my Prusa i3 MK3S. At the same time, insufficient cooling when printing only a single part is effectively avoided.
	Fan Speed	0%	
	Maximum Fan Speed	50%	
	Regular/Maximum Fan Speed Thresh	8s	
Support	**Generate Support**	Off	Support is only needed for the part “Fuselage1”. Details can be found in the project file FuselagePart1.3mf.
Build Plate Adhesion	**Build Plate Adhesion Type**	Brim	A brim is used for most plane parts. Exception are parts that provide good bed adhesion without brim.
	Brim Width	3.0mm	This width value is typically sufficient to achieve reliable first layer adhesion to the printer bed.
Mesh Fixes	**Union Overlapping Volumes**	Off	Important: Enabling these values can lead to unsatisfactory print results. Please note that some of these settings are enabled by default in many Cura profiles.
	Remove All Holes	Off	
	Extensive Stitching	Off	
	Keep Disconnected Faces	Off	
	Merged Mashes Overlap	0.0mm	
	Remove Mesh Intersection	Off	
	Remove Empty First Layers	Off	
	Maximum Resolution	0.5mm	These are default Cura settings. They can be used to adjust the

	Maximum Travel Resolution	0.8mm	computational burden for the 3D printer. Older 3D printers may require larger values to achieve smooth print results.
	Maximum Deviation	0.025mm	
Experimental	**Slicing Tolerance**	Exclusive	Important setting to ensure proper slicing of the parts.

Low Weight PLA requires a few specific settings which differ from standard PLA. Please use these settings for the STL files with '_LW' name extension.

Cura slicer parameter		**Default setting**	**Remarks**
Quality	**Layer Height**	0.3mm	Thanks to foaming of the material higher layer heights can be used without loss of layer adhesion.
	Initial Layer Height	0.3mm	LW-PLA sticks also very well to heated print beds.
Material	**Printing Temperature**	230°C	This value gives nice foaming result (>200%) and at the same time keeps stringing lower compared to higher temperatures.
	Flow	50%	This default value creates walls that are a bit thicker than 0.4mm. This is done by intention as it allows to further reduce the visible gaps caused by the rib structure at the bottom of the parts after sanding.
Speed	**Print Speed**	42mm/s	These print speeds allow for an increased travel speed to minimize oozing during travel moves. The surface quality remains excellent.
	Outer Wall Speed	28mm/s	
	Travel Speed	180mm/s	
	Initial Layer Speed	21mm/s	
Travel	**Retraction distance**	2.2mm	This value strongly depends on the type of extruder used with the printer. The default value is suitable for LW-PLA with direct extruders (e.g., Prusa i3 MK3S). Bowden extruders typically require larger values up to a few mm. Please note that it is impossible to completely avoid oozing of LW-PLA during travel moves. The best solution is to minimize travel moves by design.

Experimental	**Slicing Tolerance**	Middle	Important setting to ensure proper slicing and to obtain a nice surface finish at the bottom side of the LW-PLA parts after sanding the rib areas.

Decal sheets

The set includes PDF files (600dpi, letter and A4 format) to print decals for the Howard DGA-5 “IKE”. The original plane used black aircraft registration letters in the first years which were later partly replaced by golden letters. Unfortunately, gold is a special color that can only be approximated by the RGB or CMYK color space. With the provided decals, I have tried to approximate the golden color. Black registration letters are provided as an alternative.

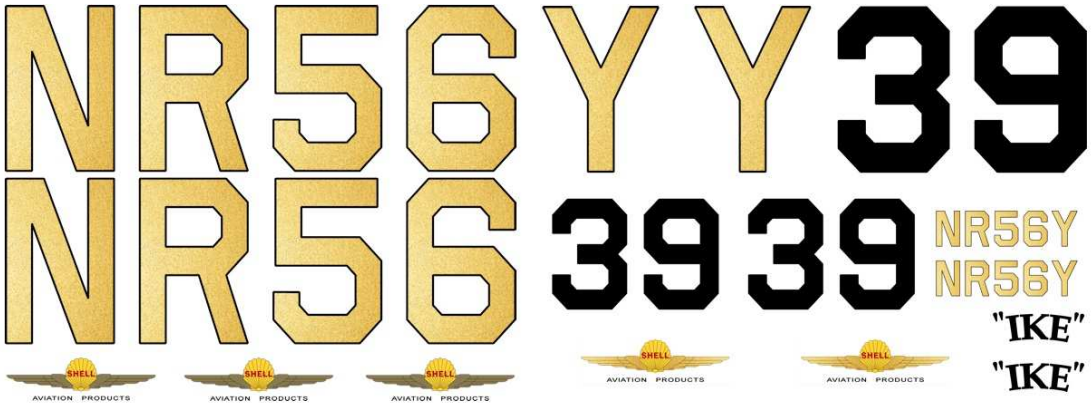


Figure 5: Decal sheets with golden registration letters

Figure 6: Decal sheets with black registration letters

Assembly

Step by step video guide

This video guide is based on version 1 of this 3D printable Howard DGA-5 “IKE”. Some parts of version 2.2 look slightly different but the assembly process is almost identical.

[Howard DGA-5 “IKE” – step by step video guide]

Chapters:

00:15 > Right wing
04:02 > Left wing
05:18 > Combine wings
06:49 > Servo cover
07:43 > Fuselage
16:59 > Tail
24:04 > Landing gear
31:24 > Decals
33:56 > Radio control
39:06 > Flying wires
41:26 > Final check

Noteworthy changes in assembly for version 2.1

There is now the option to insert a carbon fiber pipe into the center area of the wing. Doing so, further increases the stability of the wing and should ensure endurability even for all cunning aerobatic figures. Please make sure to check if the pipe fits into the prepared hole in the wing parts before gluing them together. Insert the carbon pipe latest before you glue both wing halves together.

Noteworthy changes in assembly for version 2

The rudders, stabilizers, ailerons, and wing servo covers of the airplane are now optionally available for printing with LW-PLA. The design of these parts has been modified to minimize extra travel moves of the nozzle during the print process and to partly compensate for the reduced stiffness of the foamed PLA. At one side of the print (bottom side except for rudder) the rib structure becomes more visible along the surface. As shown in Figure 7, this visual effect can be easily minimized by sanding the area around the rib structure.

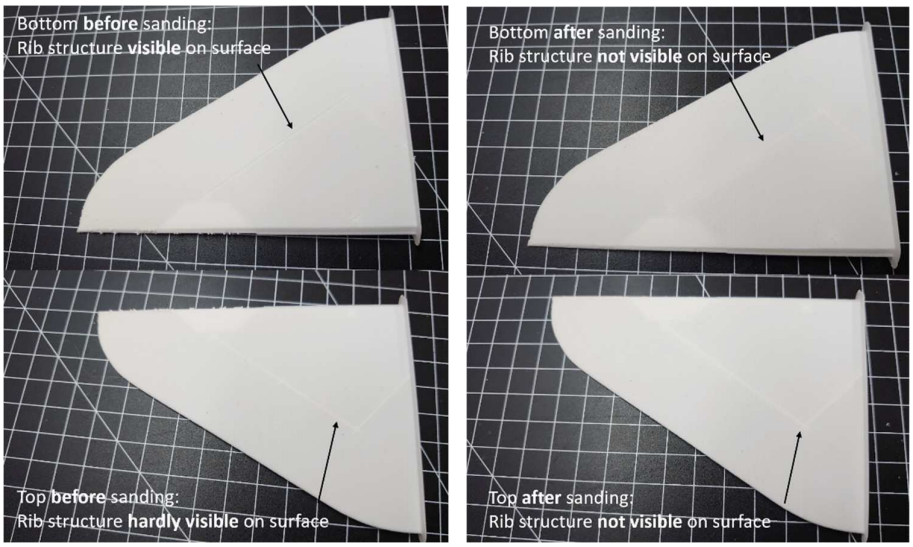


Figure 7: ElevatorL2 before (left) and after (right) sanding

The LW-PLA horizontal stabilizers and part Fuselage6 feature tubes to optionally insert a 2mm carbon fiber rod as can be seen in Figure 8. The rod is intended as alternative for the tail flying wires. (Wings and landing gear do not require flying wires at all for stabilization.)

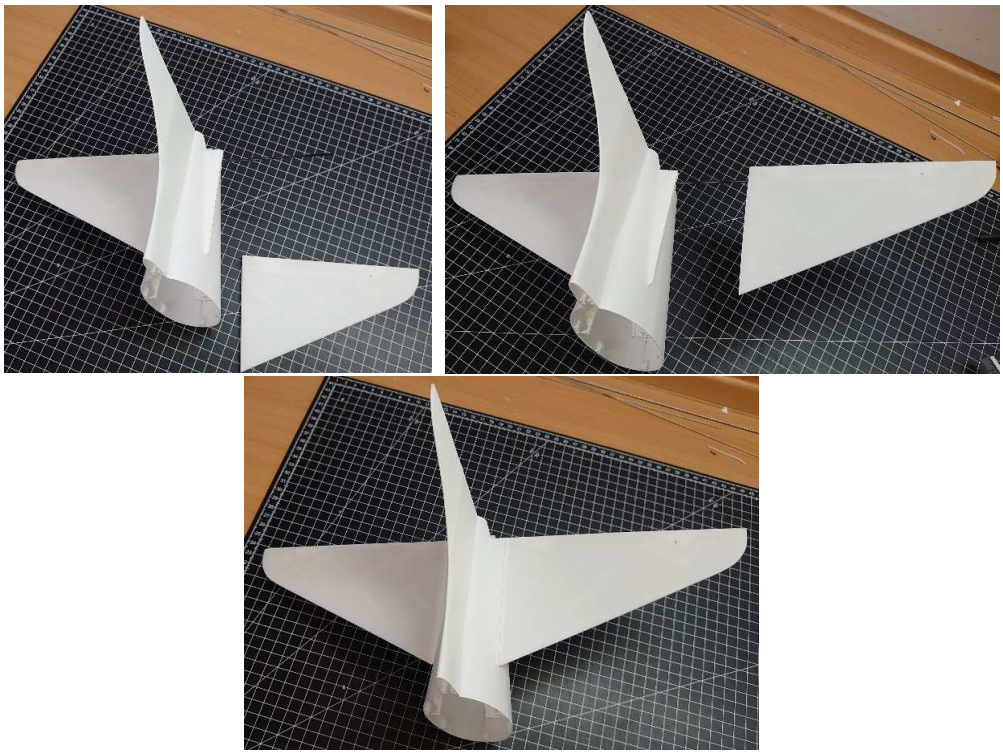


Figure 8: Optional 2mm carbon fiber rod to for stabilization

The main landing gear has been weight-optimized with version 2. This is mainly realized by reducing the diameter of the spring steel wires from 2.0mm to 1.5mm. To ensure robustness, the crossbar became slightly thicker. Overall weight reduction is approx. 13g resulting in a total weight of of 68g. Also the tail wheel became more light-weight by reducing the diameter of the spring steel wire from 1.5mm to 1.0mm and optimizing the weight of rim and tire. Total saving is approx. 2g.
Despite these weight optimizations the landing gear remains robust.

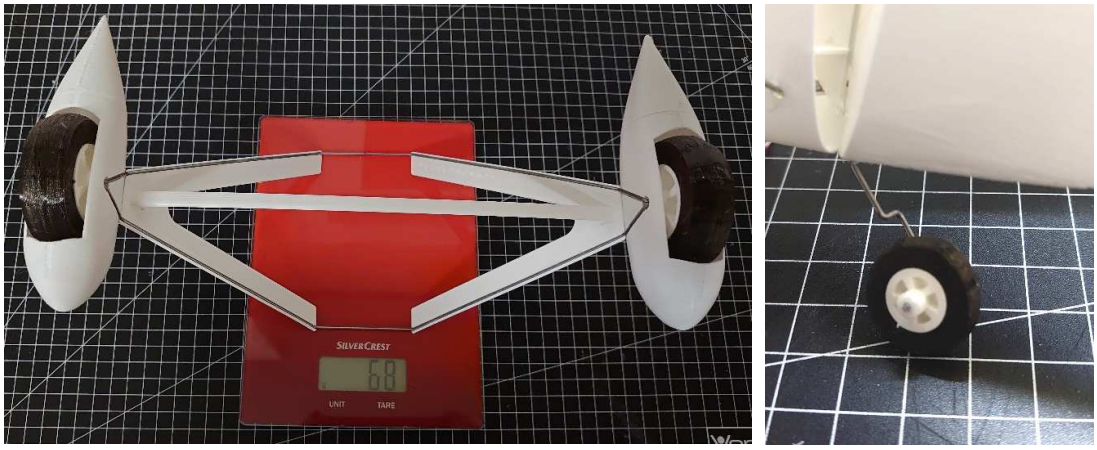


Figure 9: Weight-optimized landing gear and tail wheel

Now connectors can be used to simplify the step of exactly aligning and gluing together both wing halves. The assembly process is comparable to the fuselage parts. Figure 10 depicts WingL1 and WingR1 with connectors inserted in WingR1. Please note that this change only applies to the central wing parts.

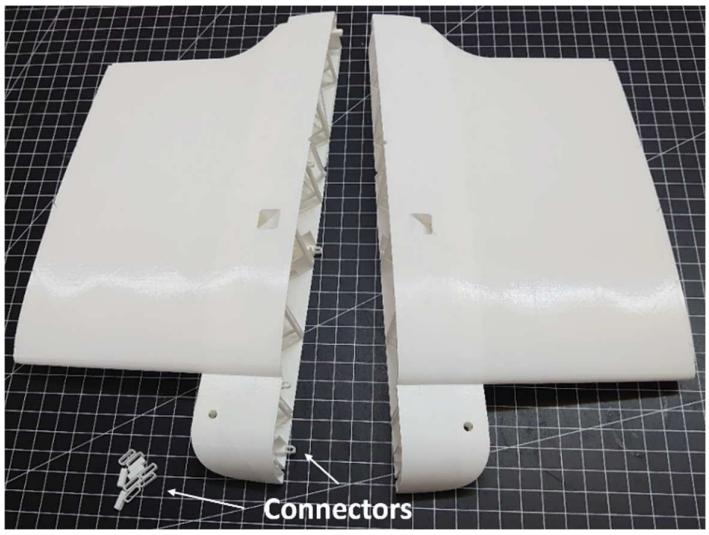


Figure 10: Connectors are available to simplify the alignment of left & right wing halves.

Fuselage1 now offers the possibility to fix the motor cables with a cable tie as shown in Figure 11.

Figure 11: Motor cables fixed to the fuselage

Another useful modification is the extension of the battery compartment. Version 2 provides more degrees of freedom in the choice of battery type and size which is especially useful in combination with LW-PLA printed tail parts to adjust the center of gravity. Also, the required manual cut-out has been simplified.

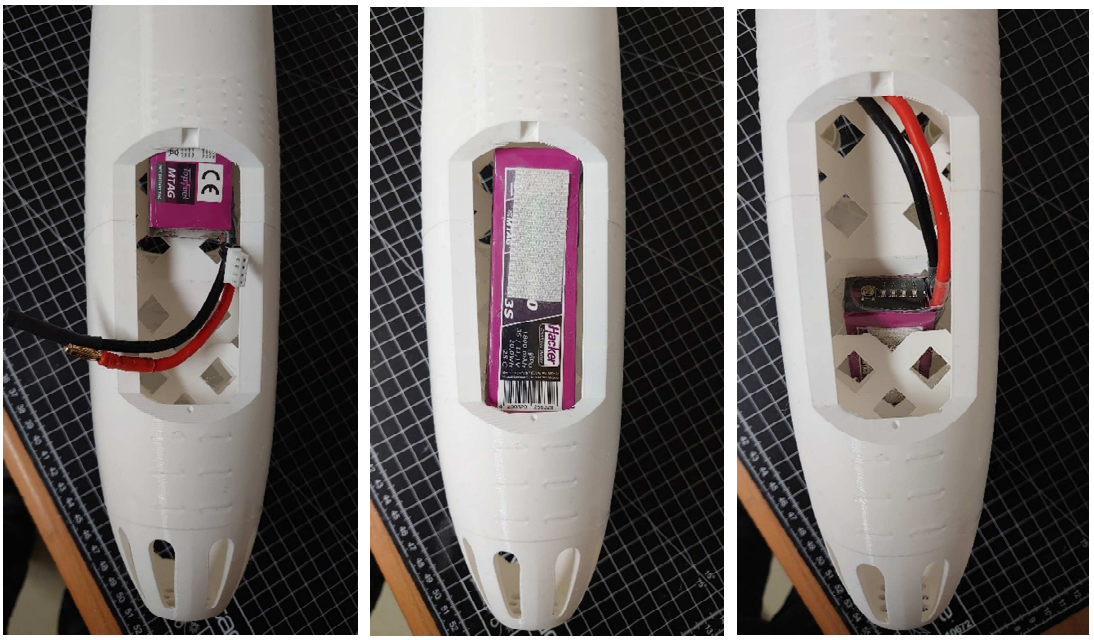


Figure 12: Extended battery compartment to adjust center of gravity

Pre-flight setting & check

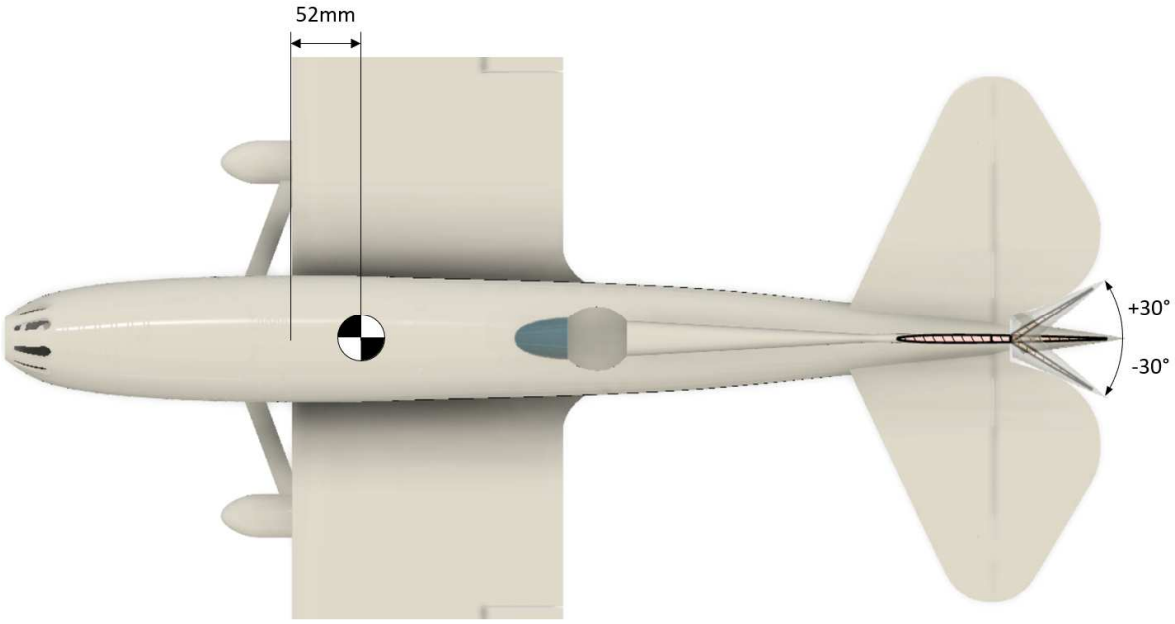


Figure 13: Center of gravity (CG) and rudder deflection angles

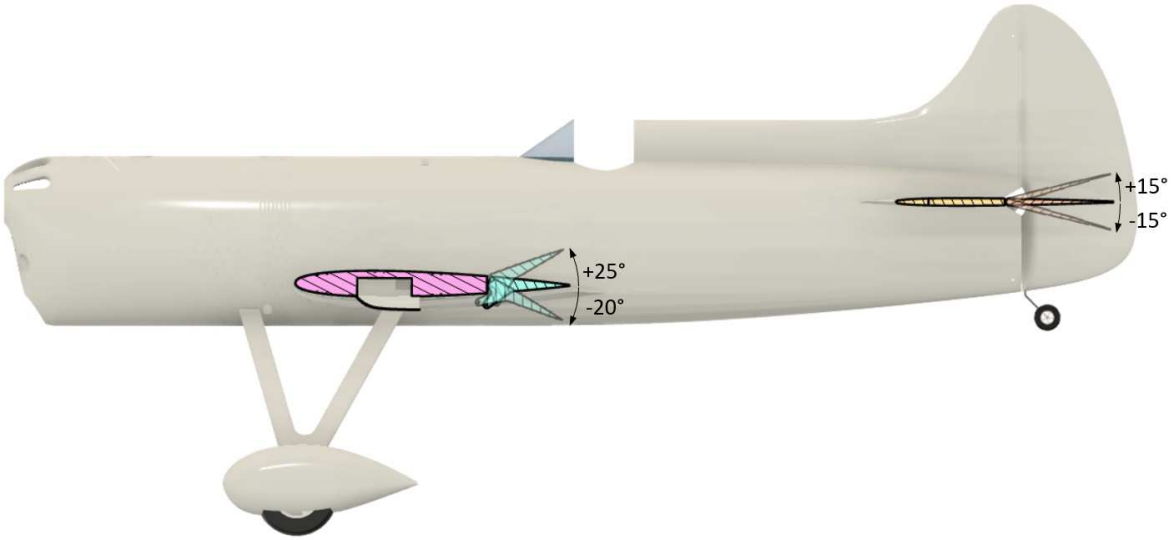


Figure 14: Aileron and elevator deflection angles

Change log

Version 2.2

- Increased engine side pull from 3 degrees to 4 degrees. This change improves the take-off behavior.
- Slightly increased the wheel opening of the landing gear wheel pants.

These are minor modifications based on customer feedback. Please feel free to contact me if you have further ideas for improvement.

Version 2.1

- Added carbon fiber pipe support for wing reinforcement to have an additional robustness margin for cutting flight maneuvers. Normal aerobatic figures with limited g-force such as a larger looping, turn or roll do not require such additional reinforcement.
- Increased fuselage louver openings for improved scale impression – looks even greater!
- Reinforced landing gear wheel pants and crossbar.
- Reinforced internal structure of main wheels.
- Fuselage bottom seam part optimization for print quality improvement

Version 2.1 weighs 35g more compared to version 2 at the benefit of reinforced structures where needed. This additional weight is around the center of gravity.

Version 2

- Support of LW-PLA printing for weight-critical components with a total print weight reduction of approx. 50g.
    - Stabilizers, rudders, ailerons, and wing servo covers can be optionally printed with LW-PLA. Note that the weight reduction of the tail parts allows to additionally save motor and/or battery weight of up to 70g due to leverage with respect to center of gravity.
    - The LW-PLA horizontal stabilizers and their connection to the fuselage feature tubes to optionally insert a 2mm carbon fiber rod. The rod is intended as alternative for the tail flying wires.
    - Provision of modified STL files, gcode for each part and Cura project files with all required LW-PLA print settings.
- Extension of the compartment for the battery (and the ESC).
    - Provides more degrees of freedom in the choice of battery type and size, especially in combination with LW-PLA printed parts.
    - Simplified the required cut out of the battery compartment
- Weight reduction of the landing gear by approx. 13g.
    - Mainly realized by reducing the diameter of the spring steel wires. The crossbar is now a slightly thicker to ensure robustness.
- Improvement of all wing part connections resulting in increased stability and print quality.
    - Added connectors to central wing parts to simplify the step of exactly aligning and gluing together both wing halves.
- Further optimization of general and part specific print parameters
- Several smaller improvements