

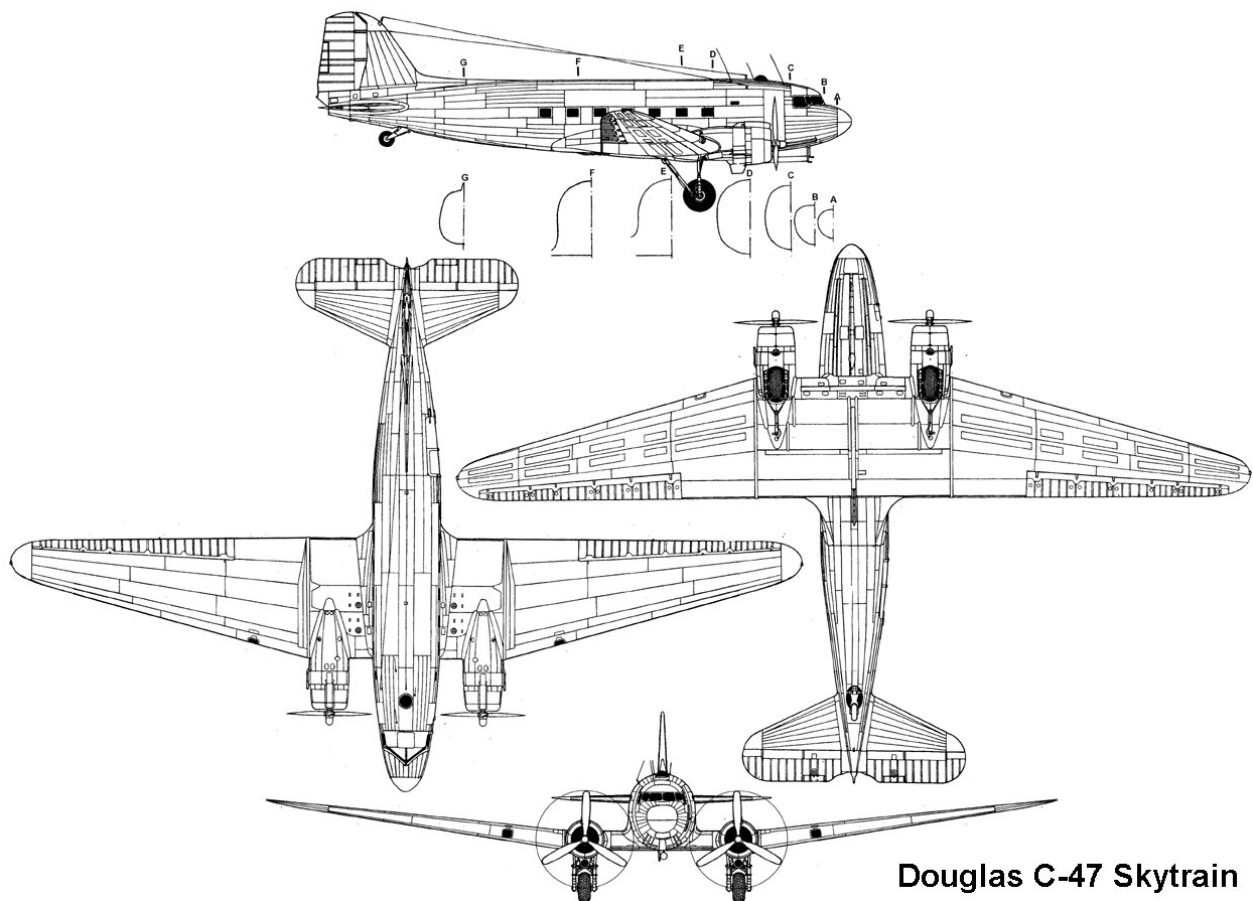
The world's most famous airplane for REFLEX XTR²

Douglas DC-3 / C-47

showing some surprising characteristics

This is an airplane that needs no introduction! You may look at Wikipedia for both the civilian [DC-3](#) and the military [C-47](#). A lot of information is also at Trev Morson's [DC-3 hangar](#) website. The DC-3 has always been a popular subject for modelers, and some of them even built the giant-scale 1:8 model after the [Nick Zirolì plan](#). Now it is available for the REFLEX XTR² model flight simulator, but that has to be explained.

From Richard Ferriere's website <http://richard.ferriere.free.fr/>:



The REFLEX models

In 2009, there was a discussion of the flight characteristics of DC-3 models in a [thread at RC Universe](#). Topic was how to achieve „real scale flight“ of models, and some experts contributed to the thread. My contribution was calculating (estimating) the aerodynamic characteristics and trying several model versions in the REFLEX XTR² simulator. That was done by creating appropriate parameter sets and using a dummy model appearance. Later, this could be replaced by a real DC-3 appearance made by fellow modeler Vichineu from Belgium, as described in the next section.

All in all, seven virtual model versions in two scales (1:12 and 1:8) were tested, and later a 1:9 version like Vichineu's was added as well as a 1:6.5 version. They all have (nearly) the same aerodynamic layouts but differ in size, weight, and drive.

Version 1 is what the original poster intended to build, a lightweight electric. Scaled 1:12, it would have 95 in wingspan and only 4.5 lbs weight. I recommended two small 2208 motors and 3s LiPo batteries, which would give a 0.37 thrust/weight ratio. Even though that turned out to be well enough, version 2 with two 2212 motors giving 0.5 T/W ratio was tried as well.

For comparison, two glow-powered versions were added. Version 3 weighs 14.5 lbs like a real model described in another Web forum. It uses two .40 four-stroke glow engines giving a decent 0.6 T/W ratio. Version 4 with the same weight and two .25 four-strokes giving only 0.37 T/W ratio is still well powered for all practical purposes.

Another [thread at RC Universe](#) (can't be found any longer) was about the Ziroli 1:8 DC-3 (143 in wingspan). One owner specified 43 lbs weight for his model and intended to build another one to only 33 lbs weight. In the simulator, version 5 weighing 43 lb was balanced like recommended by Nick Ziroli, that is with a quite forward center-of-gravity (C/G) giving more than 20% static stability margin. The lighter 33 lbs version 6 was balanced at a more aft C/G giving a still decent 15% static margin, now requiring less wing incidence angle than the full-size original. That's why version 7 with original incidence and 20% static margin was added. The 1:8 versions have 1.20 (version 5) or .91 (version 6 and 7) four-stroke engines, giving 0.53 or 0.38 T/W ratio, respectively.

In REFLEX, these versions are designated by their version numbers appended to the model name. You'll see what I mean when you go to the model selection (hit F2) and there under „Aircraft“ to the „BE / DC-3“ branch.

Finally, Vichineu's model, scaled 1:9 (128 in wingspan) and weighing 33 lbs, was rendered with my aerodynamic parameters. It has electric motors giving a huge 0.8 T/W ratio. Later, another 1:9 model has been added and set up

like the C-47 model of Heinz Jenkewitz. It weighs only 27.5 lbs and its two .91 four-stroke engines make for a 0.45 T/W ratio.

The version „DC-3 4.46m 17kg“ has been added later as well. It's a fictitious model scaled 1:6.5 with a flying weight chosen according to theoretical considerations (using the Scale Model Spreadsheet by [Alasdair Sutherland](#), which can't be found any longer). This version is meant for comparison to 1:6.5 models of the Ju 52/3m, DC-6, C-130 Hercules, and Transall C-160.

The „virtual“ testing gave the following insights:

The DC-3's wing layout is prone to tip-stalling. The original airplane is obviously designed to cruise-fly at the built-in 2 degrees wing incidence angle. At model scale (Reynolds number), maximum lift and angle-of-attack are smaller than full-size so the AOA and hence speed range is somewhat limited. With full flaps (split flaps deflected 45 degrees), stall behavior is good-natured, but maximum lift and AOA are not much bigger than in „clean“ configuration, so landing speed is not that low and three-point landings are not possible! Just land on the main wheels and let the tailwheel settle.

Because flight speed is quite slow, anyway, landings are still quite slow and short. For a scale look, one has to set decent approach power and maintain that power until the tailwheel settles or even until the model comes to full stop. Always use full flaps throughout the whole approach and landing.

Take-off is very scale-like with the small motors giving only 0.37 T/W ratio. More power lets the model just jump off the ground. Like any full-scale tail-dragger, a DC-3 model takes off more easily when the tail is lifted by some down elevator during the early take-off run. 15 degrees flaps will help the take-off as well. At full power, climbing is still possible even with full flaps.

The biggest benefit of small motors, both glow and electric, is their low weight. That is of paramount importance for any DC-3 model retaining the original wing planform. Some washout helps as well to get a more docile behavior but not nearly as much as low weight. A lightweight model is really child's play even in case of an engine failure and even with a low T/W ratio (or just on account of this).

Regardless of weight or wing loading, respectively, elevator deflection should be limited to an unusually small value (15 degrees in the simulator) to prevent the typical nasty stall at least with full flaps. More elevator throw isn't needed, anyway, since you have to painstakingly avoid stalling the model. That is best achieved by letting it mostly alone and limiting oneself to small corrections. At least that is a benefit of the huge pitch stability (static margin).

The aileron deflection should be rather limited as well (10 degrees) to avoid tipstalls. To emulate the original's Frise ailerons, 50% aileron differential has been set. Despite this and the small aileron throw there's still adverse yaw.

So the DC-3 is a „rudder airplane“ and you have to fly coordinated turns. The easiest way is to set the combi mixer giving the same amount of rudder (in %) as aileron. Observing that, roll response is good. 20 degrees maximum rudder throw is enough, even on the ground, but always hold full up elevator there to have the tailwheel on the ground and functional.

If set up properly, any DC-3 model is a great flyer if only the pilot is careful on the sticks. A smooth flying style and a decent speed management are the best qualifications for successfully flying a DC-3 model.

Practice makes perfect, and for that we have the simulator...

The REFLEX Model Appearance

In 2010, our fellow modeler Vichineu from Belgium re-built a very nice DC-3 model made by [FiberClassics](#), scaled 1:9 (128 in wingspan, 33 lbs weight):



The full-size original had been owned by the Swiss Air Lines and is now in the [Swiss Museum of Transport](#). Vichineu wanted to have it in the REFLEX XTR² flight simulator as well, so he built the model using the REFLEX model construction program RMK:



The result looks quite attractive in the simulator (and flies just as well):



Vichineu generously shares all his simulator models by offering them for download at www.RC-Sim.de (the DC-3 is [here](#)), and he even kindly permitted to bundle his model appearance with my parameters.

In REFLEX XTR, a model consists of a model file for the visual appearance, a parameter file for the flight characteristics, and two sound files for the drive sound. My parameters have been made to render the models absolutely true-to-original, following the three-view drawing shown above. That's why I had to adapt the landing gear and the flaps of Vichineu's model to my parameter settings. While I was at it, I replaced the standard propellers by real three-bladers and the included drive sound by standard REFLEX sounds.

Now someone who wants to try my DC-3 model parameters needs the modified model appearance as well, so Vichineu's permission was required. But I encourage you to try his original model with his parameters as well.

Both at RC-Sim and in the archive downloaded from there you will find his following description in French and English:

Chers tous,

Ce modèle est un gracieux et ne doit pas être utilisé dans un but commercial.

L'avion réel se trouve dans un musée à Lucerne.

Le modèle réduit (Fiber-Classics restauré après un crash) qui a servi pour les photos a 3.2 m d'envergure et pèse 15kg. Il est équipé de 2 moteurs électriques Kontronik Koratop 30/12, hélices tripales Ramoser SG 13,9 à pas variable, 2 variateurs Castle Creation HV 85 alimentés par chacun 2 packs Rhino 25c 4s4900, soit 4 packs en vol. Il vient d'être remis en vol par son nouveau propriétaire, Michel Aerts, Mellery, Belgique.

L'avion virtuel à faire voler dans le simulateur REFLEX XTR été réalisé par Roger, vichineu, grâce à RMK, à partir des photos de ce modèle réduit.

Installation :

- Comme d'habitude, le dossier .zip est à décompresser dans le répertoire "Flugzeug".

Bons vols, n'hésitez pas à donner vos impressions.

vichineu@hotmail.com

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Dear all,

This model is a freeware and should not be used for commercial purposes.

The real aircraft is in a museum in Lucerne.

The model (Fiber Classics restored after a crash) which was used for the pictures has 3.2 m wingspan and weighs 15kg. It is equipped with two electric motors Kontronik Koratop 30/12, SG 13.9 Ramoser 3-bladed propellers with variable pitch, 2 Castle Creation HV 85, 2 packs Rhino 4s4900 25c for each, so 4 packs in flight. It has now been sent flying by its new owner, Michel Aerts, Mellery, Belgium.

The virtual aircraft to fly in the simulator REFLEX XTR was made by Roger vichineu through RMK, from photos of the model.

Demonstration Flight

Just to give an impression of the DC-3 model's basic flight characteristics, I recorded an unskillful but still informative demo flight. It shows the biggest (1:8) but lightweight (33 lbs) version with two .91 four-stroke glow engines. To view it, hit F9 in REFLEX and under "Aircraft" select "DC-3".

Simulation Tip

In REFLEX you may try the flight behavior in case of engine failure. Go to the „Simulation parameters“ (F6), „General“ tab, and set „Probability of engine failure“ to 0.5 %/s. Take off and see what happens...

Enjoy!

Burkhard Erdlenbruch

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<http://time.hs-augsburg.de/~erd/Modellflug/textReflex.html>

More REFLEX models and the latest versions are on my page

<http://time.hs-augsburg.de/~erd/Modellflug/textDownloads.shtml>

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3D model © 2010 Vichineu