



Transparent canopy  
Detailed interior  
Rotatable propeller



Airplanes DAR Ltd. Bulgaria

# DAR 21



## VECTOR II

**1/32** SCALE

**PRECISE CARD MODEL**

*EXPERT VERSION*



# 1/32 SCALE DAR-21 VECTOR II

## Professional Version

### ASSEMBLY INSTRUCTION

The proposed DAR-21 model is comparatively easy to be build but its high level of similarity to the real aircraft, together with the small dimensions of the model require special attention and high precision during the assembly process.

Study carefully the illustrative drawings, cutouts and present instruction before starting the work on the model. Try to imagine the separate assembly phases and the purpose of each detail.

After the acquaintance with the model, you may start the assemblage. Follow the sequence given in the instruction. Cut the necessary details shortly before using them in order to avoid possible mistakes. Score all fold lines before cutting the details. The places of scoring are marked with small thin lines on the continuation of fold lines outside the parts. Try to follow the **middle** of the outlines during the cutting of the parts.

Do not be in a hurry with gluing - carefully check and shape each detail until obtaining the exact form for correct fit. Before starting the work get hold of the necessary tools: scissors, sharp modeling knife, blunt knife for scoring the fold lines, prickler, ruler, nippers and grinding paper. Additional materials necessary for the assemblage are: sheet of cardboard with thickness approximately 0.5 mm, a piece of wire with diameter 0.5 - 0.8 mm. Supply with proper glue. BISON Clear Adhesive, UHU or similar are recommended as the most appropriate ones. Water based glue is not recommended. Preparation for assembling includes gluing page 4 that contains formers and strengthening elements on a cardboard. Note that if you prefer to work with thin paper connecting stripes, you'll have to print the page 2 one more time on normal 80 g/m<sup>2</sup> paper.

Start with the cockpit as it is shown on the view A and B. Be very careful with gluing the canopy frame 6 and wings holder / sealing of the cockpit 1-5 to the transparent parts 6t. Carefully shape the subassembly and don't leave messing with glue. The transparent windows of the cockpit should be crystal clear. Glue the interior areas of the cockpit doors 6a and 6b leaving 2 mm free spaces to the bottom and sides of the doors. On these places the interior cover of the central fuselage segment will be glued later.

Continue with the interior – pilot's and observer's seats, flying controls and the instrument panel as it can be seen on the views C. Then assemble the central fuselage segment shown on view D. Complete the fuselage subassembly preparations with building its rear part /view E/.

After preparing the sub assemblages needed, you can complete the fuselage, following view F. Please note the following: Each subassembly view shows the parts or sub subassemblies needed, but not the final result. As a rule the completed subassembly can be seen somewhere in the next views of the instruction drawings. So you can refer to view F in this case to receive some impression how the fuselage subassemblies should look like. The same holds true to the fuselage itself. Just look forward at the View K to see it completed.

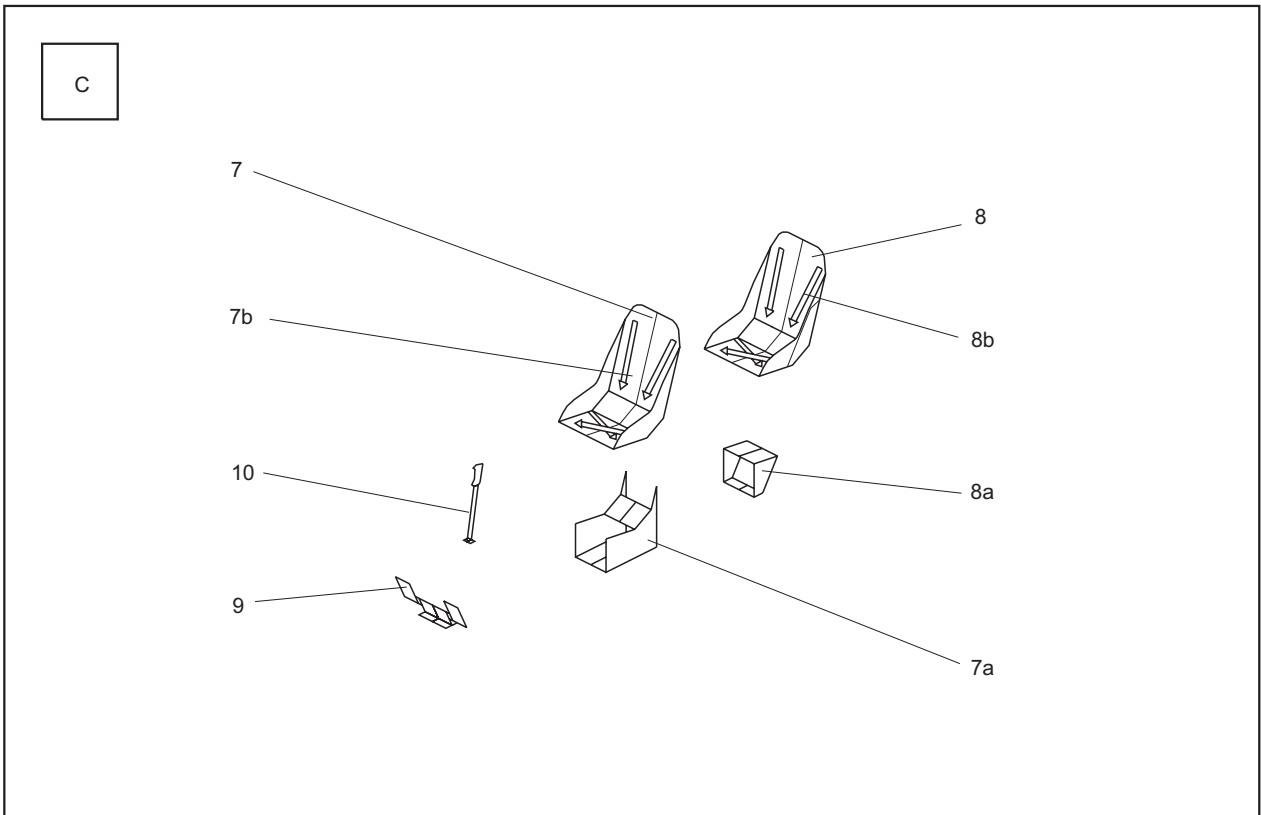
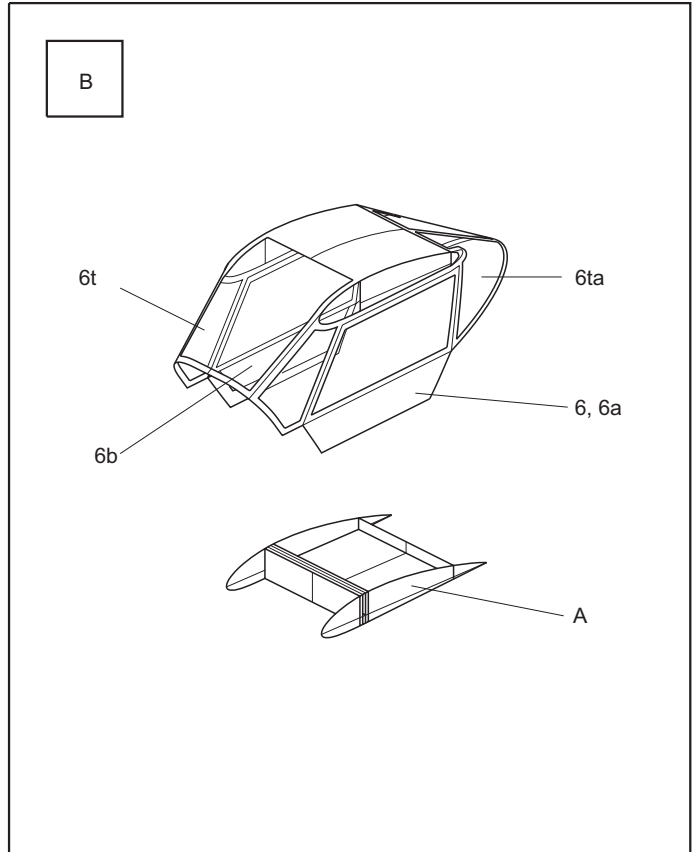
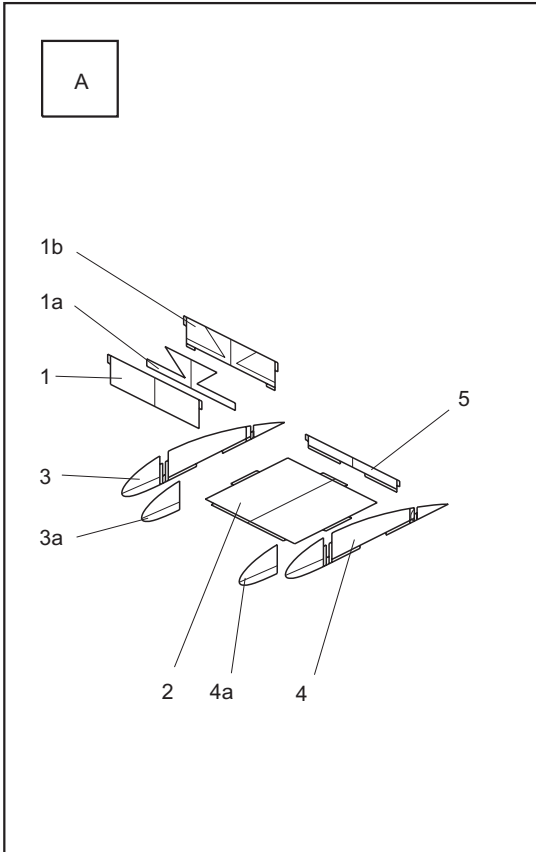
Now go to the wings and the tail surfaces - horizontal and vertical stabilizers. You can choose integrated or separate control surfaces – ailerons, flaps, rudder and elevator. In case of separate control surfaces choice, cut the unnecessary areas following the middle of the lines, marked with red scissors sign.

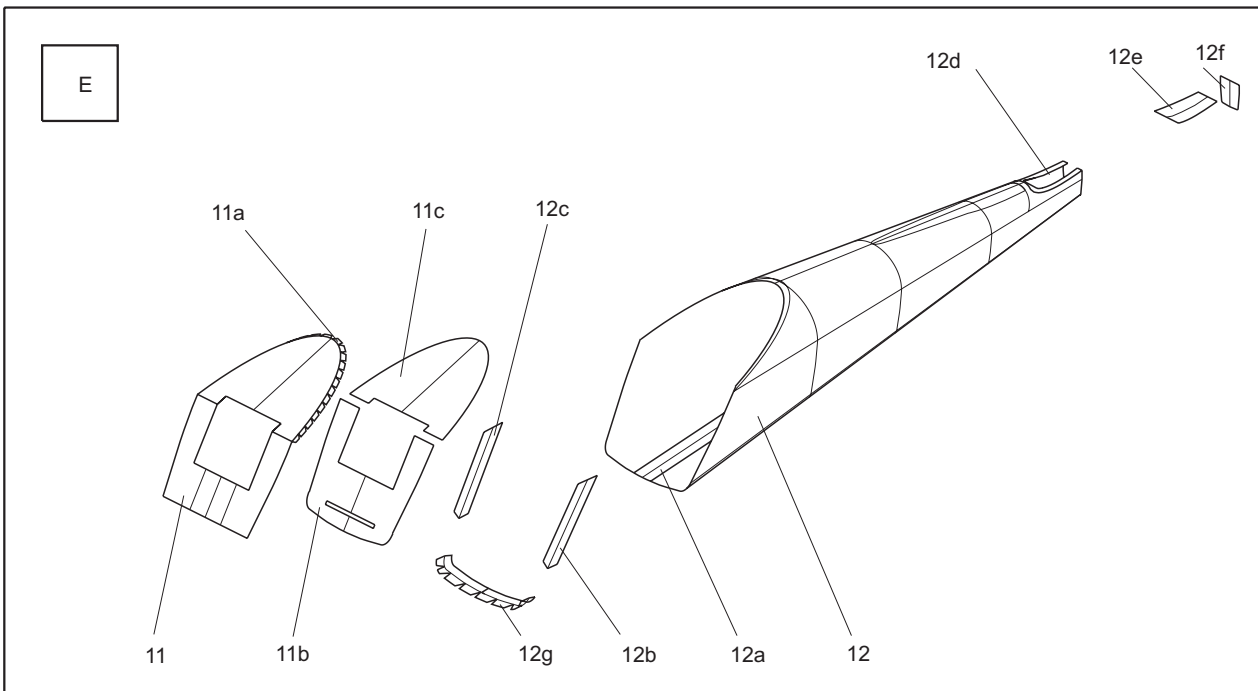
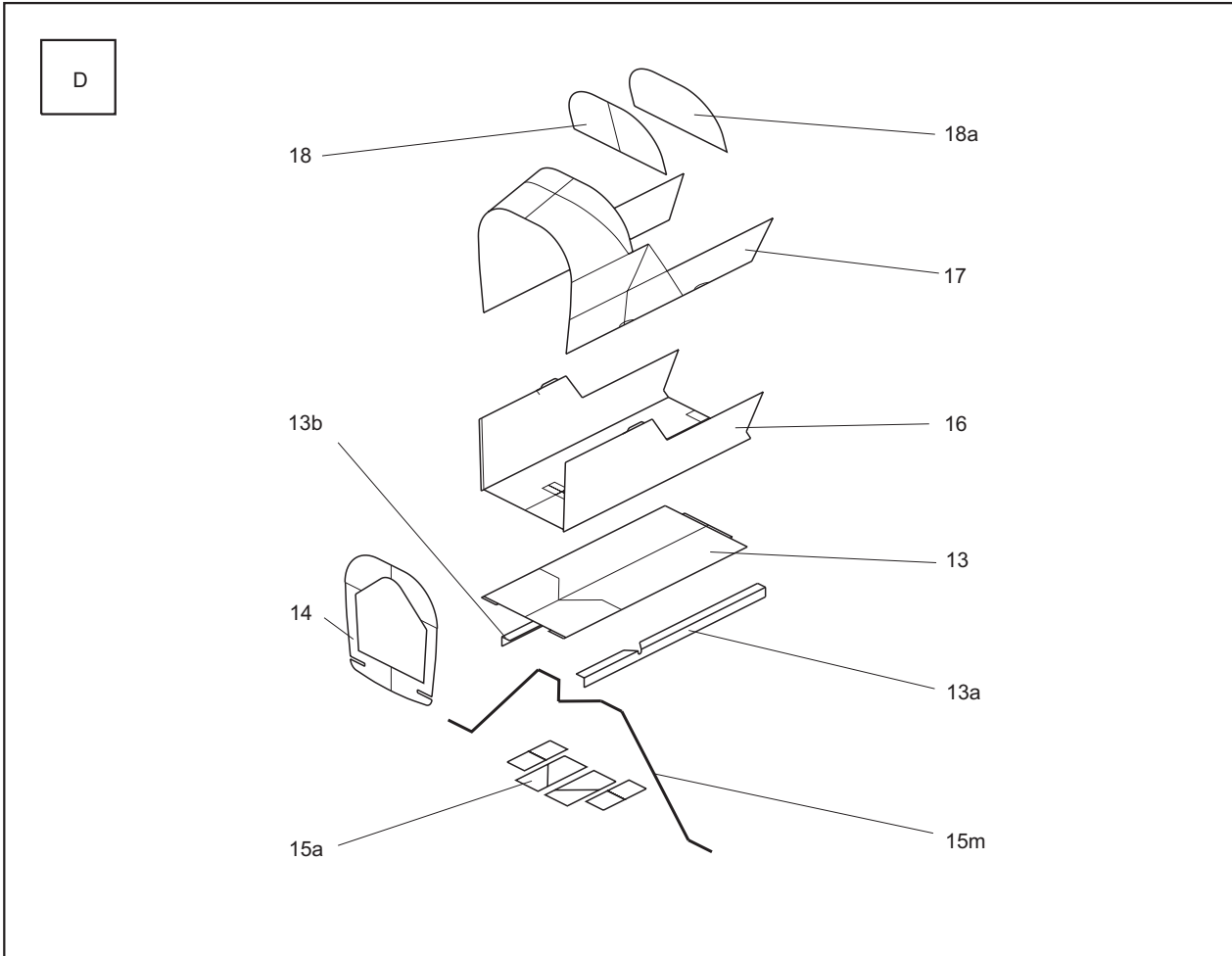
Assemble also the engine compartment together with the propeller /View J/. The propeller should be capable to rotate freeing its bearing formed by parts 42 f, h and 42g, where the axle 46m should be inserted and axial fixed with the delimiter 51.

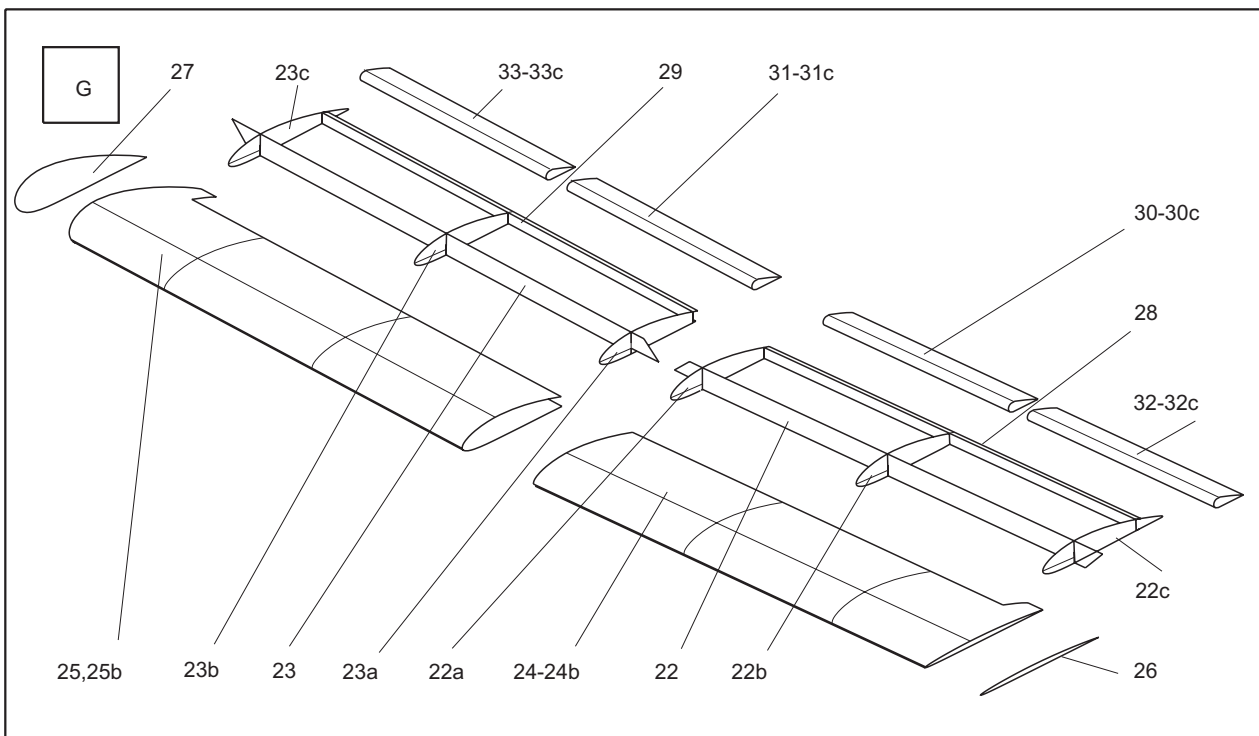
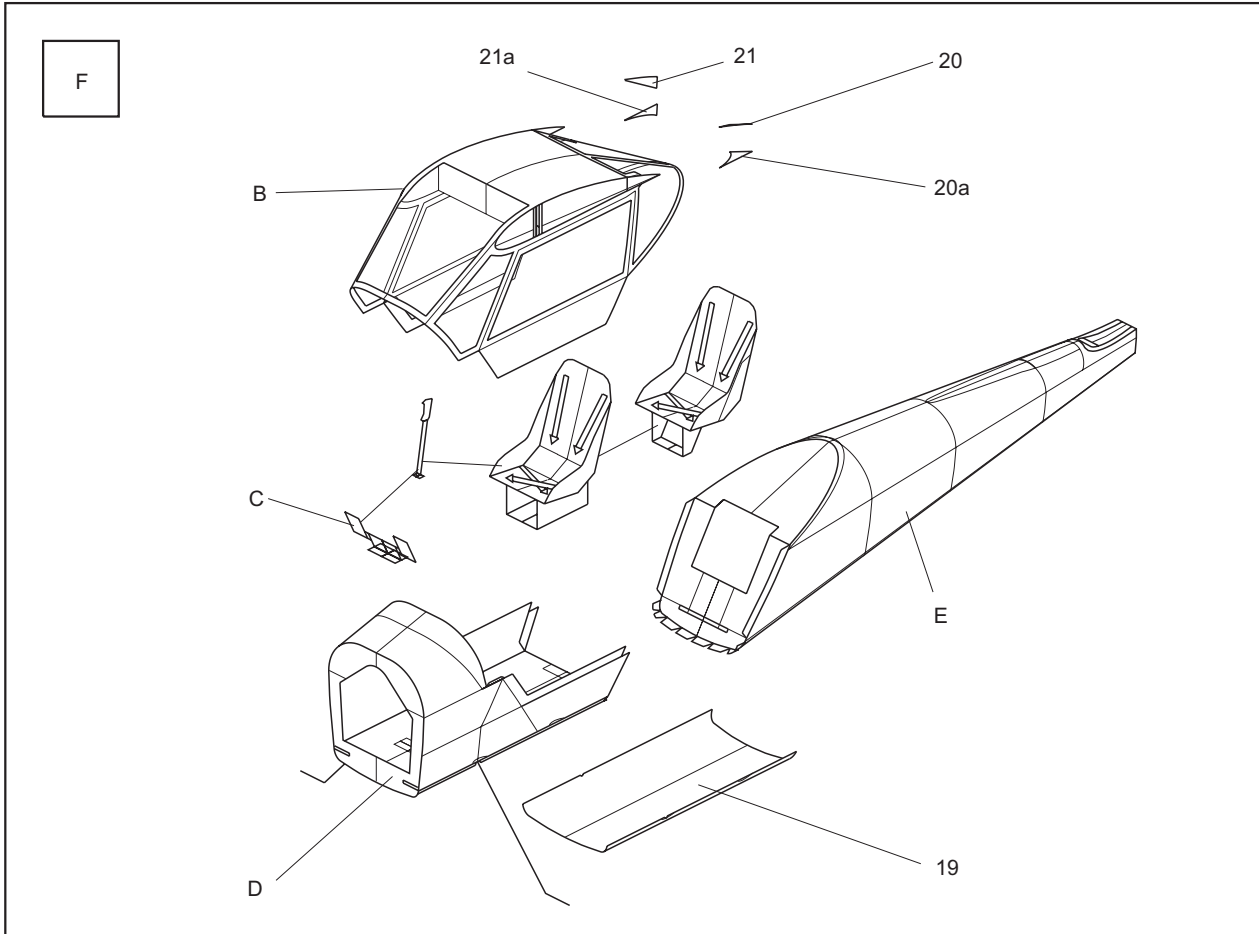
Complete the view F works with building the main wheels 55 together with 56 and 58 fixations, optional undercarriage cowlings 57, 58, wing legs cowlings 52, 53, tail wheel parts 59, 60 and the wing support parts 61, 62.

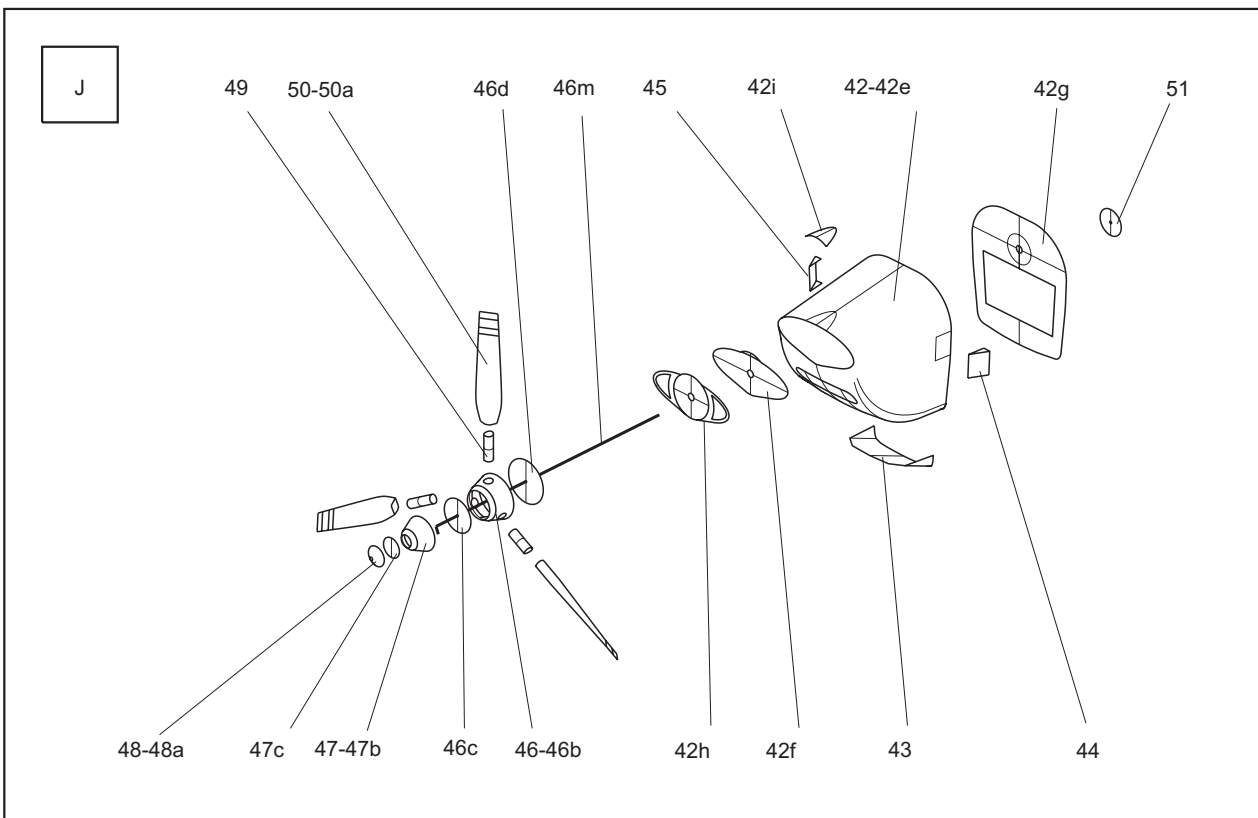
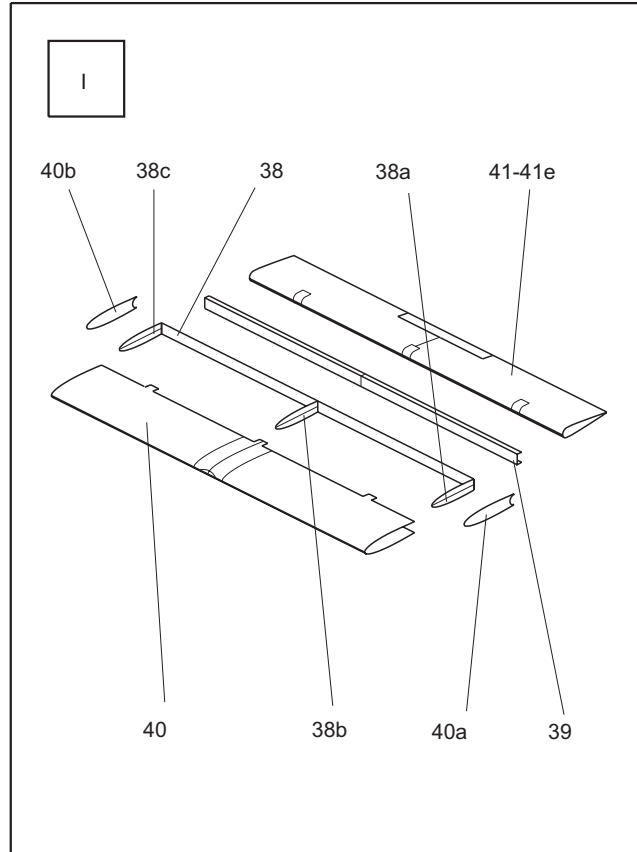
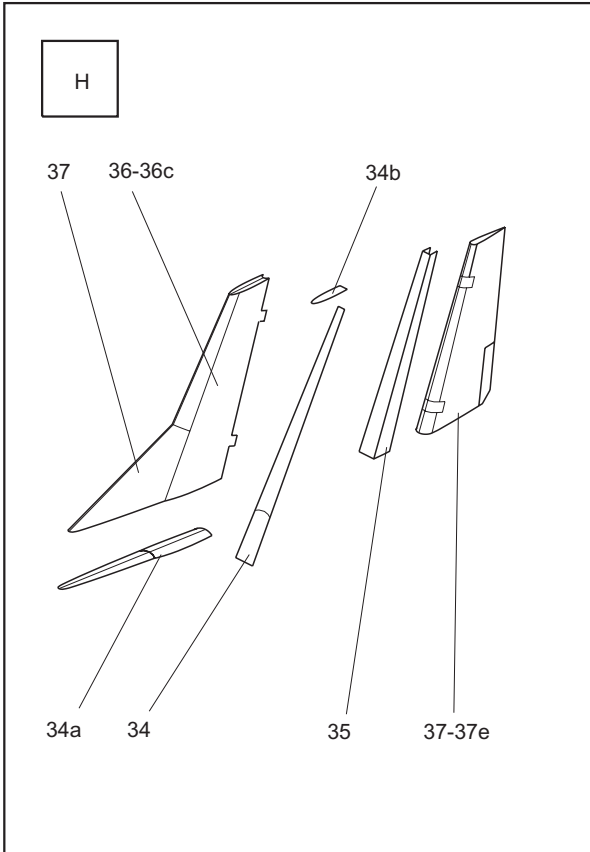
The view I6 shows the result of the assemblage till now as it should look like, plus some details like JPS, CELL and USW antenna masts plus cargo compartment equipped with cameras .

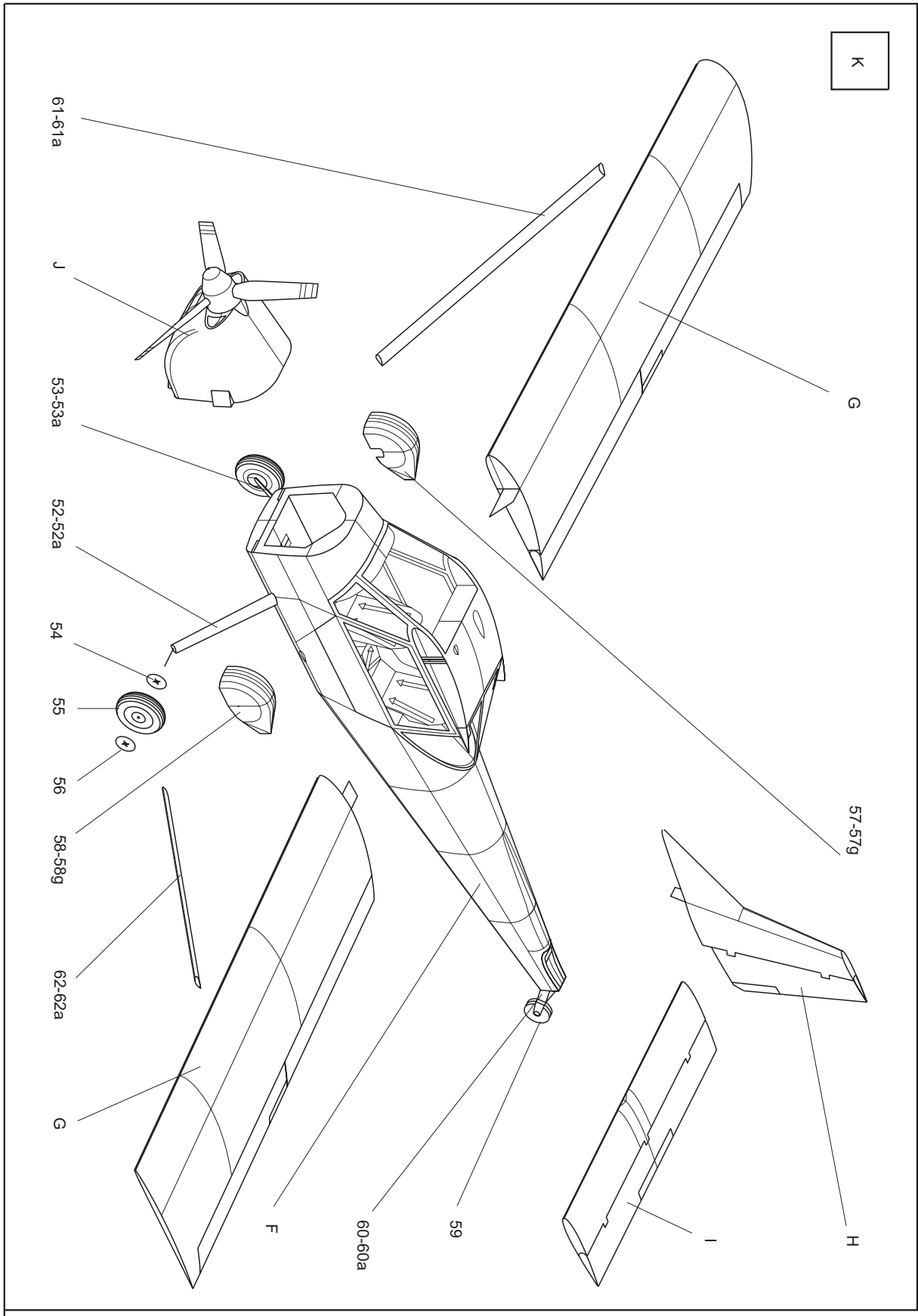
Enjoy...



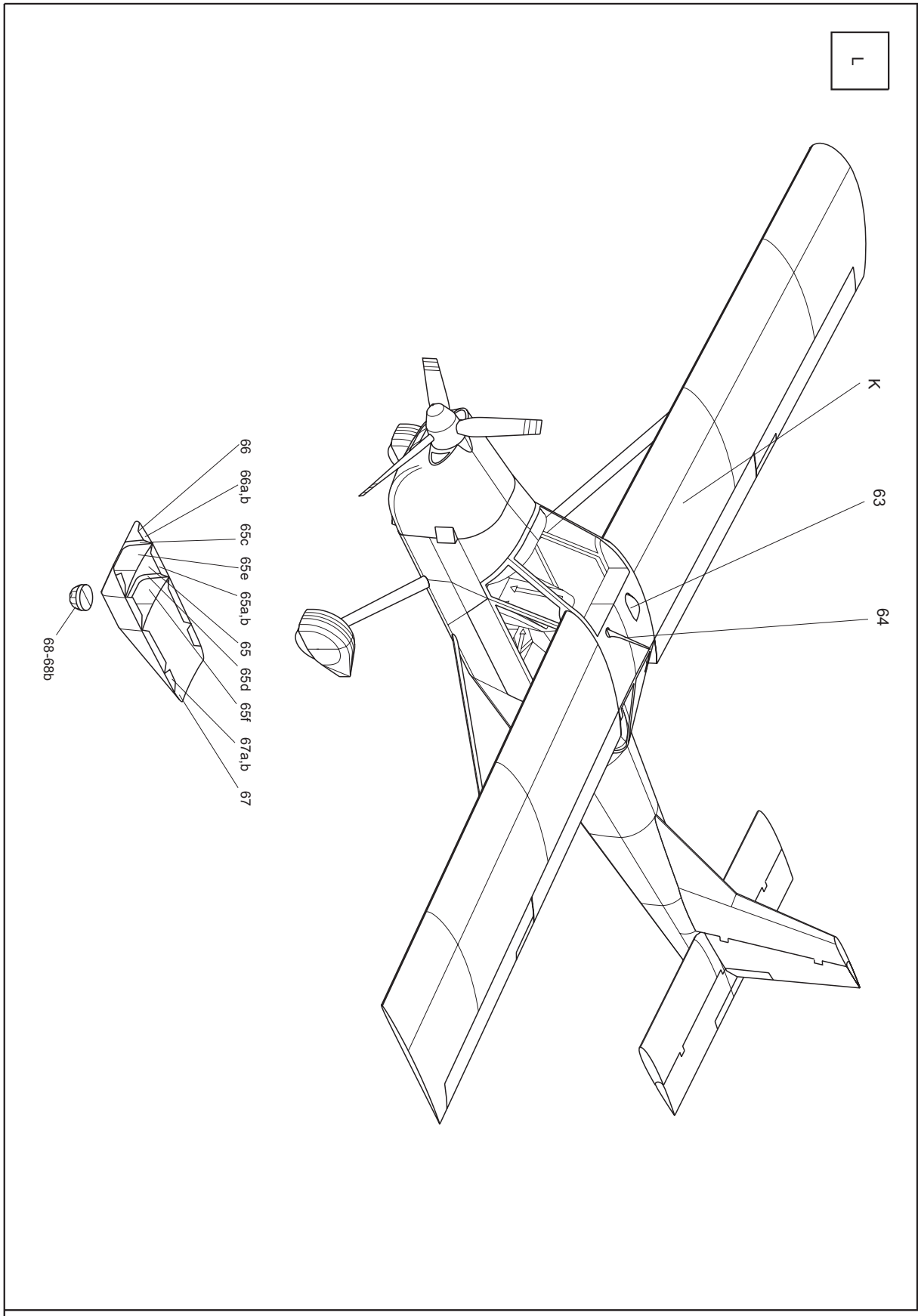












DAR-21 VECTOR II  
DIGITAL VIEWS

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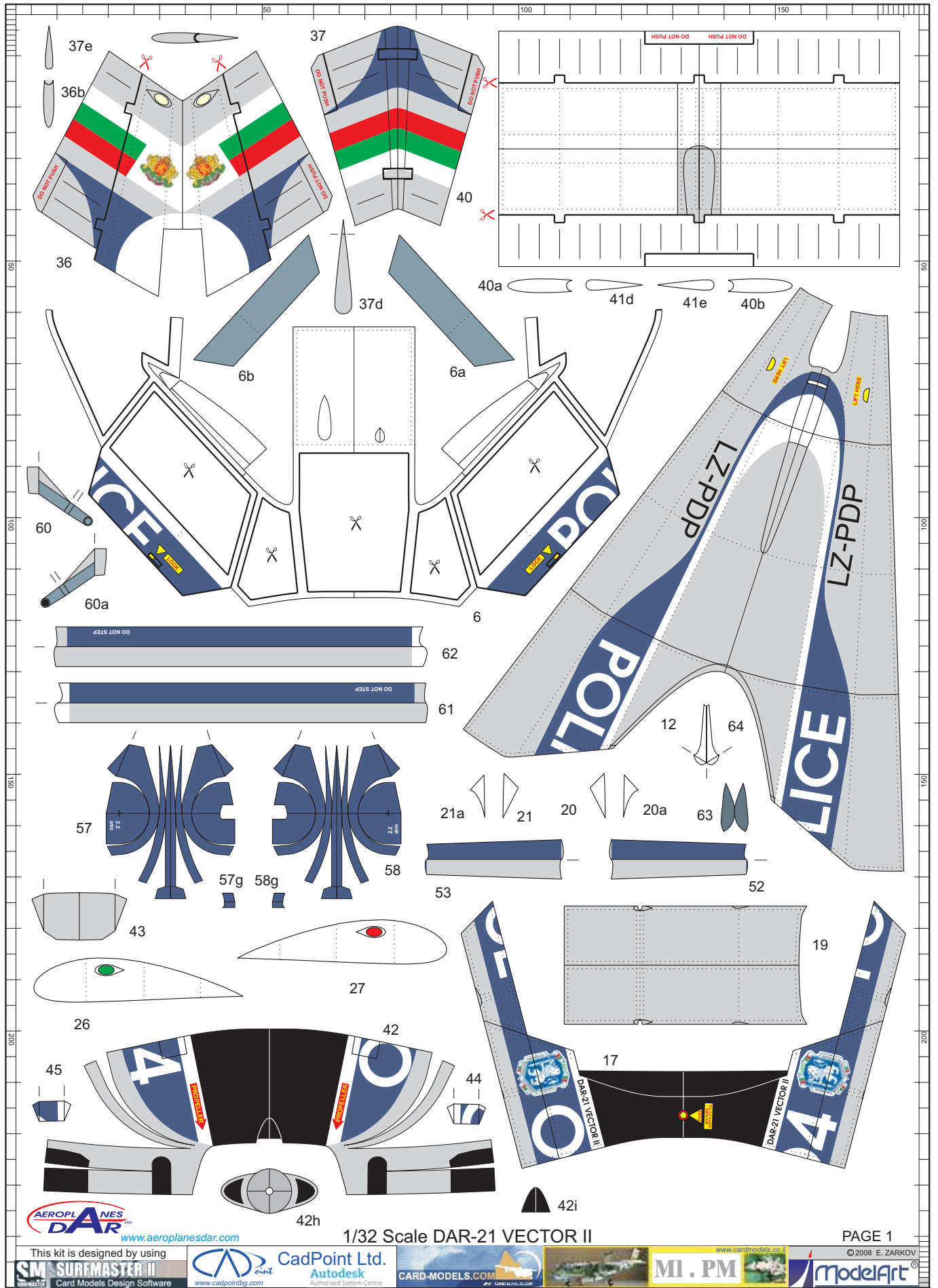
This kit is designed by using  
**SM SUREMASTER II**  
Card Models Design Software

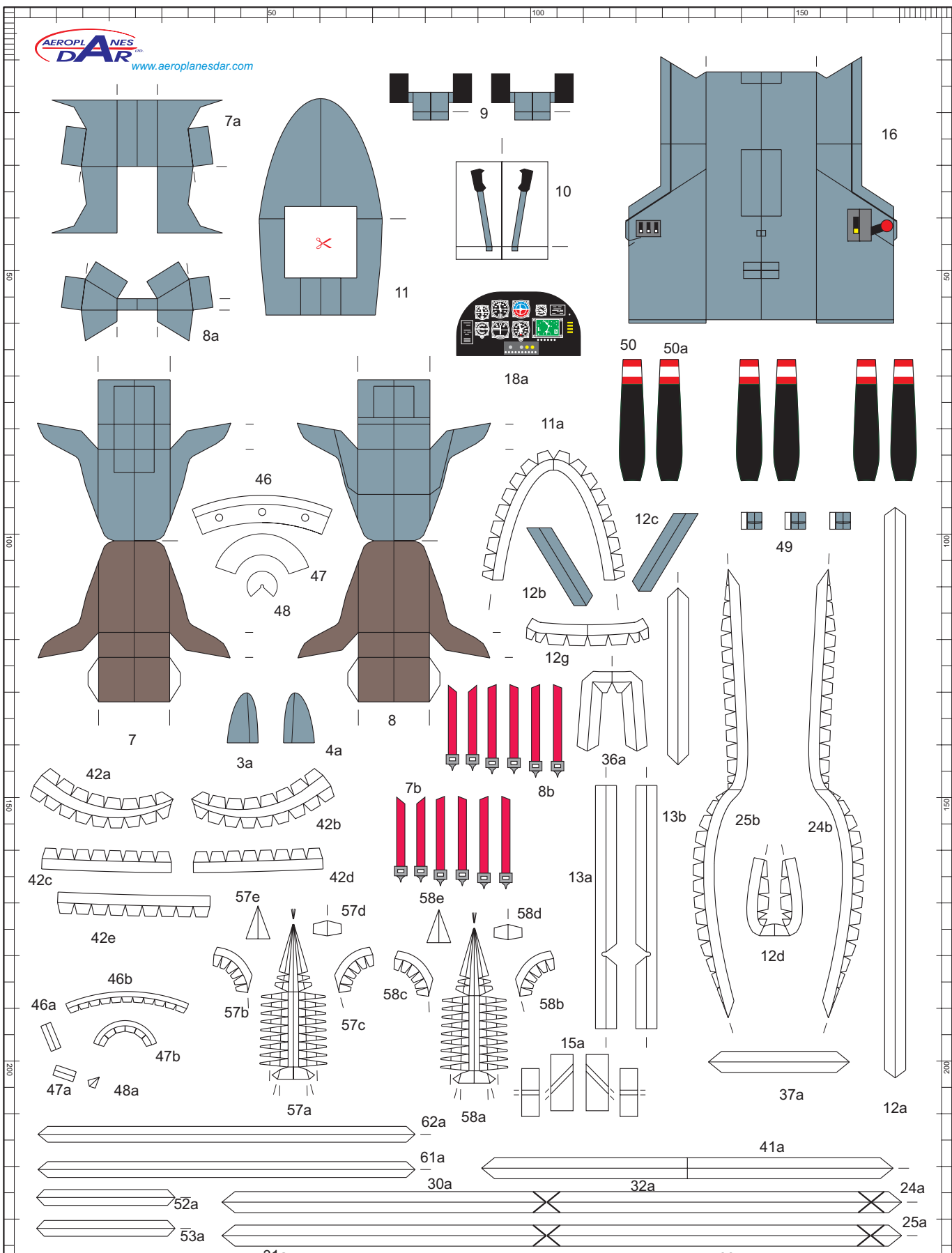


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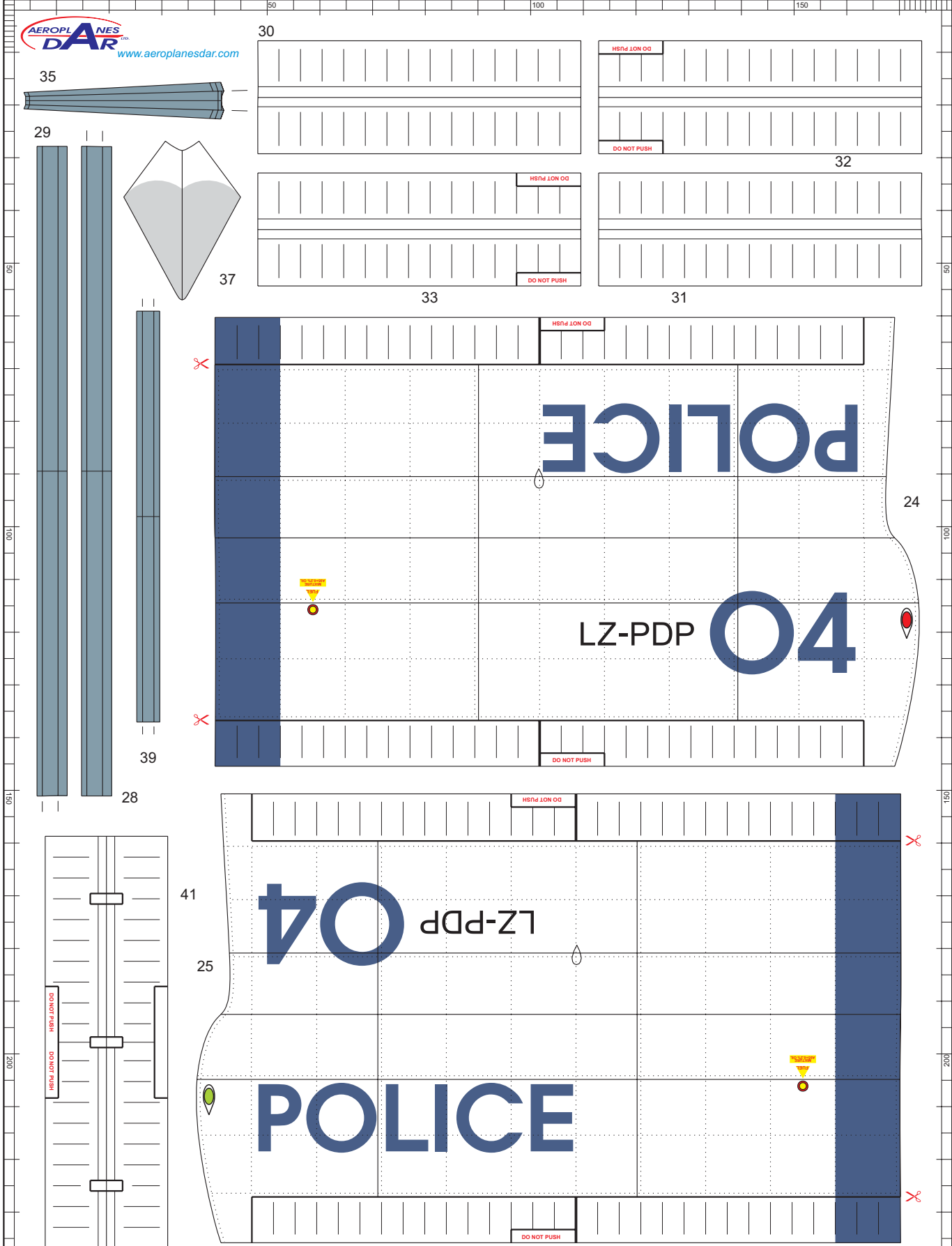
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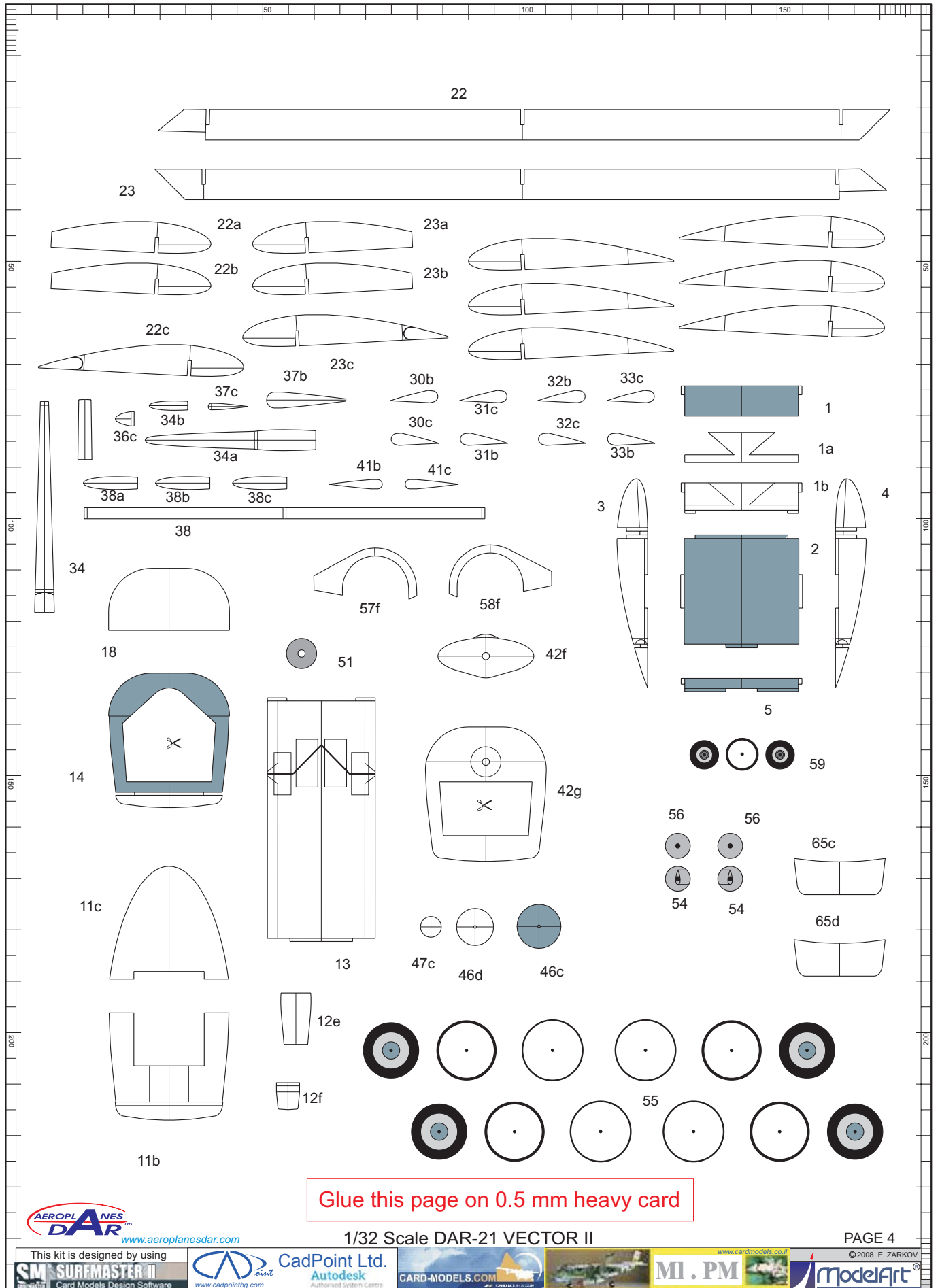




1/32 Scale DAR-21 VECTOR II

PAGE 2





Glue this page on 0.5 mm heavy card

1/32 Scale DAR-21 VECTOR II

PAGE 4

AEROPLANES  
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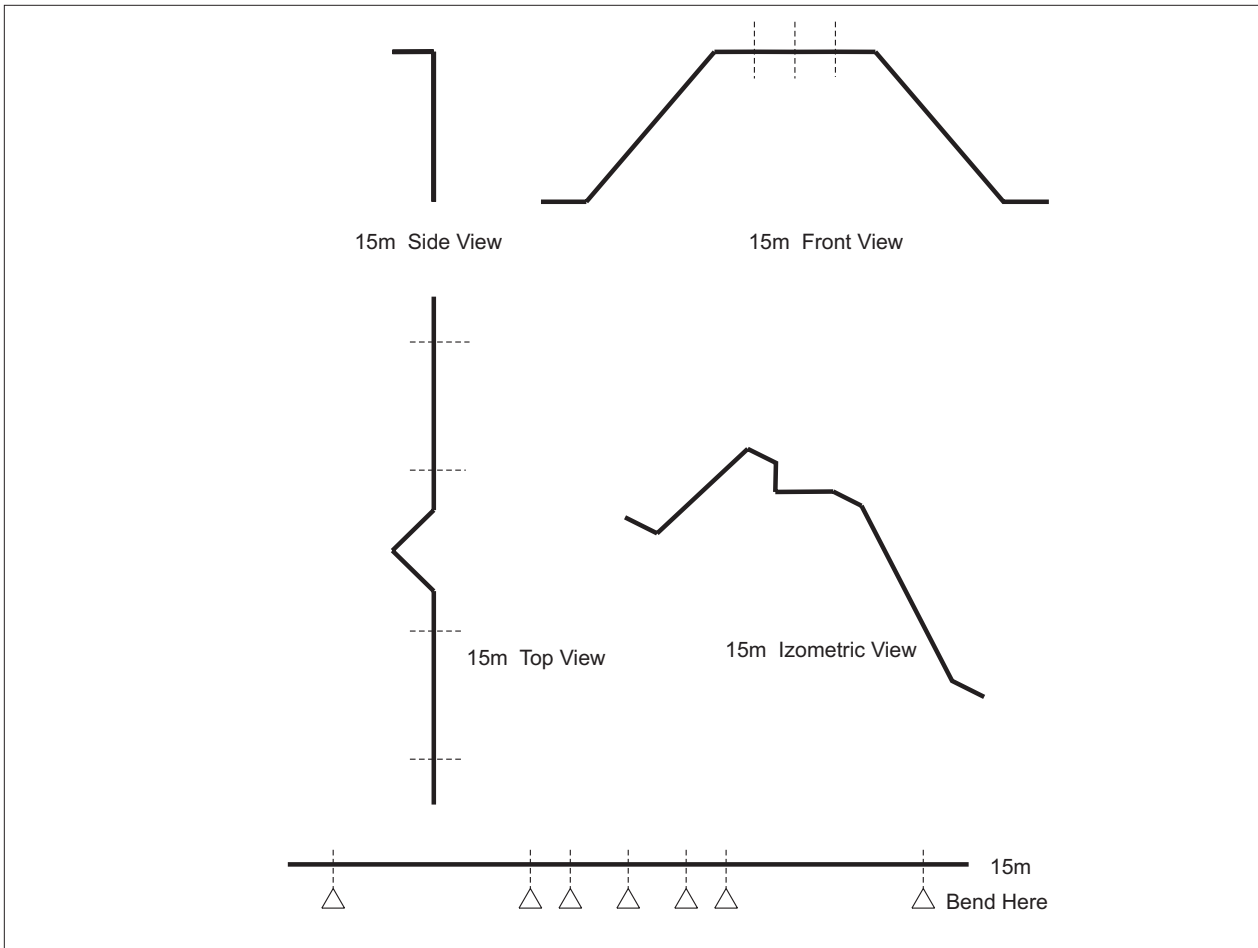
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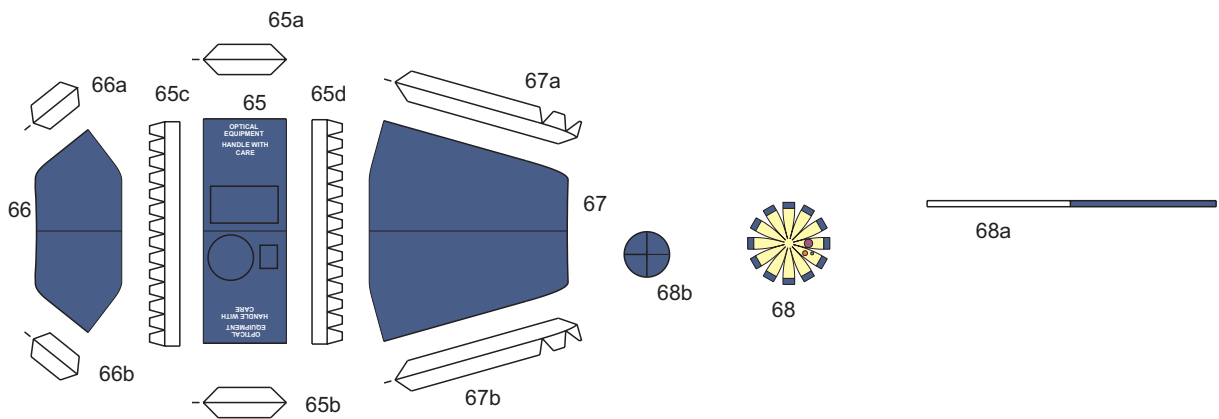
ModelArt  
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PRINT THIS PAGE ON 160 g/m<sup>2</sup> CARD



STENCILS FOR WIRE METAL WIRE PARTS

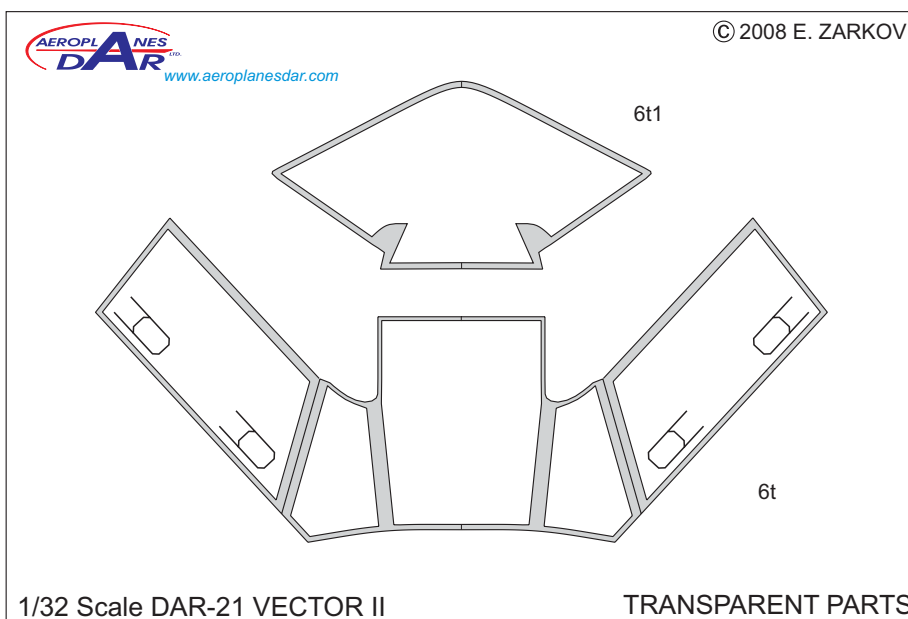
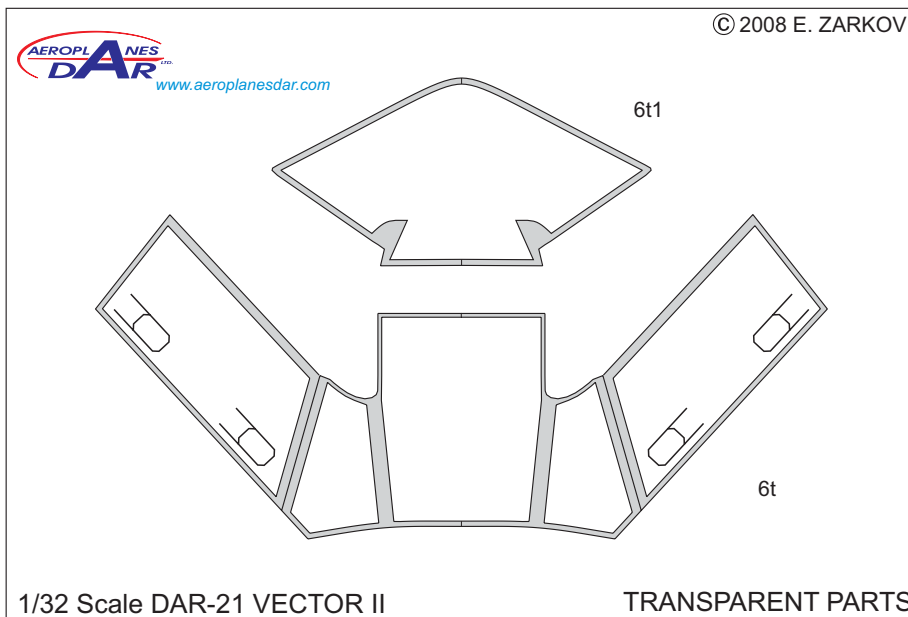
Make this parts from 0.6 mm metal wire



TRANSPARENT PARTS

**WARNING**

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FOR LASER PRINTING  
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USING UNAPPROPRIATE MATERIAL  
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LASER PRINTER!





***PRESENTATION  
of  
"Aeroplanes DAR" Ltd***

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## ***INTRODUCTION***

This booklet, published by the "Aeroplanes DAR" Company Ltd, presents products - DAR-21, DAR Speedster, DAR-23 and DAR-25 a line of light two-seater airplanes. The gamma of airplanes is completed with new four seat twin engine DAR-241. It shows some of its applications and perspectives.

Here you will find the prerequisites for the creation of the product, as well as its implementation in technical, industrial, ecological and political aspects.

As a pilot-flown aircraft DAR is a highly-technological product. The intellectual potential ("know-how") invested in this product is unique and goes beyond assessment.

The following facts must be well-remembered:

DAR-21 is the first all-metal aircraft built in Bulgaria.

This is the first procedure of the Civil Aviation Authorities considering an airplane designed and built in Bulgaria and the first issued Airworthiness Certificate for a fully designed and built in Bulgaria airplane by Bulgarian Civil Aviation Authorities.



## ***COMPANY PROFILE***

Founder of the "Aeroplanes DAR" Company Ltd is Tony Dencheff Ilieff, Eng.

Main activities as per Court's Resolution:

- Production and servicing of aviation equipment, materials and spare parts;
- Sport and commercial aviation;
- Commercial activity home and abroad;
- Commercial mediation;
- Representation and agency of Bulgarian and foreign companies home and abroad.



## ***SHORT HISTORY***

In the autumn of 1995 the few engineers with Tony Ilieff ahead started to work on a series of projects of light two-seat airplanes. Their aim was to work out a model to be produced in Bulgaria. In 1996 the DAR-11 project was launched. With a view to a better economical and maximum effective spending of the limited resources (time and financial funds) the technical project was worked out sticking to practice-proven classic solutions. Many technological checks were done. The body of the airplane was built as a frame construction - out of thin-walled seamless steel tubes. The

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main wing elements were made of wood. After an accurate technical and economical analysis of the opportunities offered by the already tested technological solutions for achieving the final goal - maximum technological and suitable for line production airplane construction, we decided to change the technological approach.



In May 1998 the DAR-21 project was launched. There was no need to use different (both in character and level of complexity) technologies. At the beginning of June the prototype (a trial version) of DAR-21 was put into effect.



On 1<sup>st</sup> of April 1999 the prototype passed the strength static tests with flying colors. On 22<sup>nd</sup> February 2000 the registration

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procedure of DAR-21 airplane started. At that time there was no corresponding data base in the official documentation of R.Bulgaria. So the Ministry of Transport and Communications (MTC) set up a committee with representatives of the MTC, of the Technical University – Sofia, Aviation Department (TU) and of the "DAR" Ltd. This committee worked out requirements for creating experimental aeronautical vehicles with a weight up to 1000 kg. On the basis of these requirements the CAA Director-General issued an Order for appointing a technical committee with representatives of the MTC and TU which inspected DAR-21 and its documents and gave permission for carrying out the flying tests. On 28.06.2000, after the committee inspection, a Registration Certificate was issued.



A test pilot was trained and approved by the MTC according to the prepared by the "DAR" Ltd Company programs for flying tests. The flying tests were authorized by the CAA Director-General with Order No. 45-01-67/31.07.2000 to be performed on the premises of the Bojuriste Airfield. The Order for flying tests got ahead of the Regulations publishing with more than 6 months. The conducted flying tests started on 01.08.2000 and ended on 25.08.2000 - 105 flights were operated totaling 41 hours and 10 minutes. All fulfilled exercises and results were recorded in the protocols of the

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flying tests. These protocols were submitted to the CAA on 04.09.2000 and this was the end of the test programme. The results of the flying tests beat all expectations. DAR-21 laid not only the technological foundations but also the administrative ones for that type of aviation in Bulgaria.



DAR-21 is the first all-metal airplane constructed in Bulgaria. This is the first CAA procedure considering an airplane designed and constructed in Bulgaria as well. All airplanes produced in Bulgaria were constructed by the military forces and never used in civil aviation. On January 18<sup>th</sup> 2001 the CAA Director-General issued the final Airworthiness Certificate No. II-1. That act brought to an end the legalization of DAR-21 airplane.

*Presentation of "Aeroplanes DAR" Ltd*



"DAR" Co. Ltd prepared 15 books (instructions and descriptions) and 26 documents (letters, protocols, etc.), while the CAA issued 30 different documents (orders, reports, letters, certificates, etc.). This is indicative of the enormous work done by the two teams - that of the DAR company and the CAA one.

The maiden flight of the airplane was on the second aviation show "Flight for everyone 2000" organized by AOPA - Bulgaria, held on September, 30<sup>th</sup> 2000 at the Bojuriste Airfield. The airplane operated several demonstrative flights including a demonstration with the agrochemical system - those were the first flights viewed by spectators.

On February, 28<sup>th</sup> 2001, the Agency for small and average business awarded the special prize for "The Product of the year 2000" and "The Project of the Year 2000" to the DAR-21 airplane.



Presentation of "Aeroplanes DAR" Ltd



In December 2000 "DAR" LTD started to work on the new models DAR-23 and DAR-23 enclosed. It was worked out mainly as a training airplane for basic training. The DAR-23 prototype was completed in August 2001 and was transported to the Bojuriste Airfield. On August, 23<sup>rd</sup>, 2001 the registration procedure of the airplane started. The DAR-23 enclosed prototype was completed in May 2002 and joined flying tests.



***Presentation of "Aeroplanes DAR" Ltd***

The DAR-23 and DAR-23 enclosed airplanes are perfect for primary training of pilots. It are light and easy to operate – its stable "conduct" reassures beginners. The airplanes flies in a steady and stable manner even without power. Controlling the nose wheel provides a very precise ground operation (taxiing, taking-off and landing). The main scheme of the wheel carriers guarantees gentle landings but allows hard ones, too.



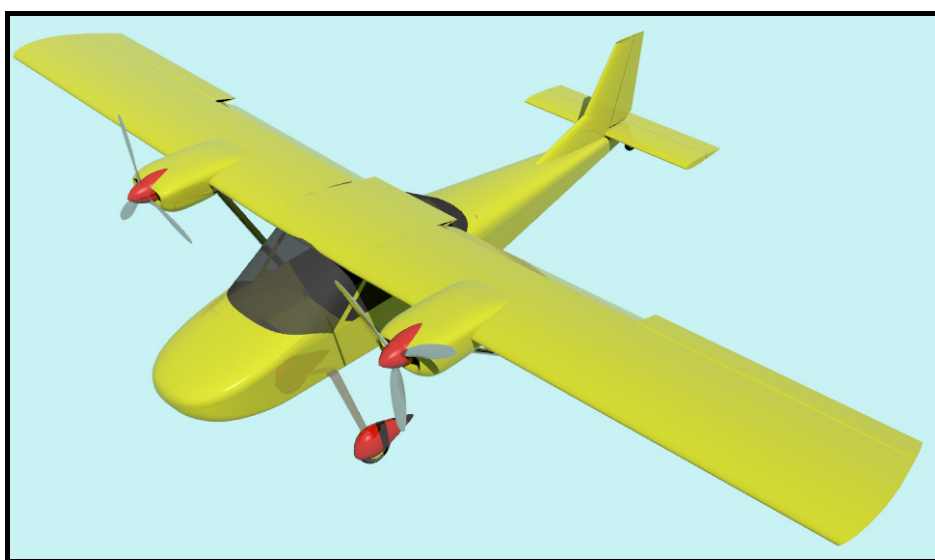
*Presentation of "Aeroplanes DAR" Ltd*

Developing continue with bigger version of DAR-21 the DAR-21 S. This aircraft start producing for French market.



Demonstration airplanes with registration Nos and LZ-DAP (DAR-21) are based on the Kalimanci Airfield (Varna), LZ-DAF and LZ-DAH (DAR-23) are based on the Bojuriste Airfield (Sofia).

On summer 2006 start developing new four seat, twin engine airplane DAR-241. The expected performance give serious advantage against all competitors on the market



## ***PRESENTATION OF DAR-21 "Vector" AND DAR "VectorII" / "Speedster" AIRPLANES***

The aim of DAR-21 project of the "DAR" Co. Ltd is to work out the technical documentation of a light two-seater, single-engine airplane, to build a trial sample, to test and certify that sample, and, in the long run, to organize its line production. The product cycle is planned to be a closed one and done here, in Bulgaria. Two main market versions are envisaged for its line production - an airplane "Ready to fly" and a set of airplane parts to be put together on one's own at home, the so called "Homebuilt aircraft kit". As a result DAR-21 is not just the first Bulgarian airplane to be put together on one's own even by amateurs, but it is also a unique product on the East-European aviation market.



The main function of DAR-21 airplane is to be used for sport, tourist and training flights. This airplane could be used with additional equipment for agrochemical treatment of agricultural crops, for transport and courier services, for advertisement flights, etc.

All necessary prerequisites for gaining wide currency and turning into a popular "Experimental class" plane have been set in the work-out of DAR-21 technical project.

### *Presentation of "Aeroplanes DAR" Ltd*

The main aim of the Company is appearance and presence on the aviation market of former USSR countries as well as an attempt for a break-through in the North-American market.

### *DESCRIPTION OF THE DAR-21 "Vector"*

DAR-21 airplane is a two-seat tandem with a ROTAX 582 UL DCDI engine (65 HP) with an electric starter.

Aluminum alloys 1050 and 3105 are used as basic building materials. The welded metal parts are made of low carbonic structure steel St20, while turnery and milling parts are of structure steel St45.



The cabin is fully closed with tandem seats. There is a big door on the right side giving access to seats and cargo sector. The cabin is equipped with all necessary navigation and engine control instruments set in one panel in front of the first seat. The control system is double and allows flying both from front and rear pilot seats.

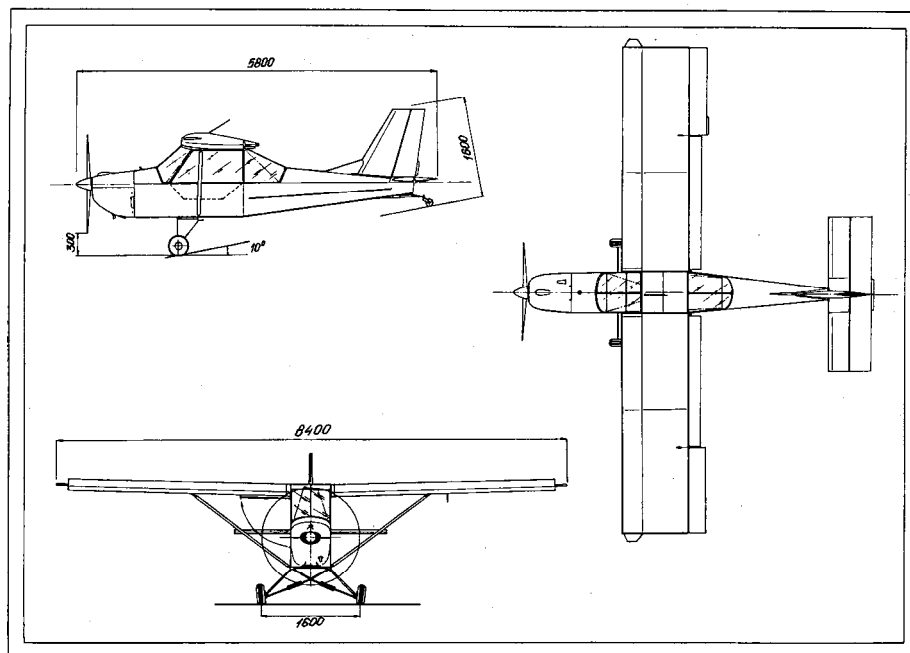
The wing is rectangular with one spar construction supported by two spurs. In order to better the take-off and landing characteristics the wing is powered with flaps deflecting at 15° during take-off and at 30° on landing. Steel cables control ailerons and vertical rudder while elevator is controlled by push-pull tube traction. All control panels are equipped with trimmers.

The fuselage is quadrangular, upside rounded. It is made of quadrate tubes and shaped metals over which a supported

### *Presentation of "Aeroplanes DAR" Ltd*

aluminum sheet is mounted. The engine capote is made of composite materials.

The landing gear is of pyramidal type, with a rubber damping. The two main wheels are equipped with mechanical brakes while the tail wheel is controllable.

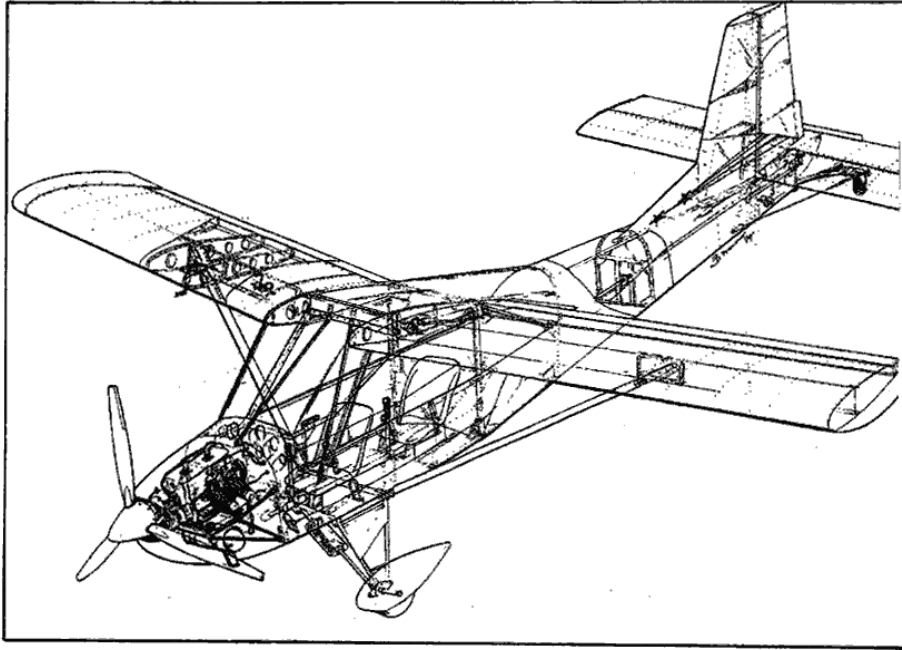


The engine frame is a construction made of welded steel tubes.

The fuel tank is situated in front of the cabin and its volume is 30 liters. Fuel flow is secured by a fuel pump.

The empty weight of the plane is 250 kg, while the MTOW is 450 kg. A cargo sector for 10 kg personal luggage is set behind the second pilot seat.

*Presentation of "Aeroplanes DAR" Ltd*



## *DESCRIPTION OF THE DAR "Vector II" / "SpeedSter"*

The new DAR airplane is a two-seat tandem with a ROTAX 912 UL engine (80 HP) or line of different 80-100 HP engines. The name "SpeedSter" was choosed for US market, for local EU market continued using name "Vector II".

Aluminum alloys 6061 and 2024 are used as basic building materials. The welded metal parts are made of low carbonic structure steel St20, while turnery and milling parts are of structure steel St45.

The cabin is same as DAR-21 but bigger and wider. The wing and the fuselage are 10% longer than DAR-21.

The landing gear is aluminum spring with hydraulic brakes on wheels.

The engine frame is a construction made of welded steel tubes.

The fuel tanks are situated in wings and its total volume is 60 liters. Fuel flow is secured by a fuel valve and pump.

The empty weight of the plane is 260 kg, while the MTOW is 450 kg.





## ***PRESENTATION OF DAR-23 AIRPLANE***

These ultralight airplanes was developed with idea to be simple, popular and low cost airplane for basic training. The maintenance of these airplanes is quite simple and not pretentious.

In flight airplane not show high performance, but to fly is easy, calm and secure, something very important for beginners.

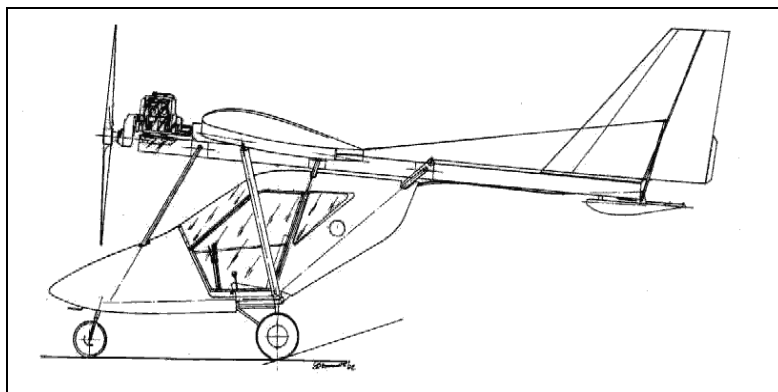
### ***DESCRIPTION OF THE DAR-23***

DAR-23 airplanes are a two-seat side by side with a ROTAX 503 UL DCDI engine (50 HP) or ROTAX 582 UL DCDI engine (65 HP) with an electric starter.



Aluminum alloys 1050, 2024 and 3105 are used as basic building materials. The welded metal parts are made of low carbonic structure steel St20, while turnery and milling parts are of structure steel St45.

### *Presentation of "Aeroplanes DAR" Ltd*



The fuselage is schematic. The base tube is prepared from quadrated strengthened tube. The cabin is mounted under base tube by six aluminum tubes. The engine is mounted in front of base tube

The cabin is open for DAR-23. The DAR-23 enclosed is fully closed, there are doors on each side giving access to seats. The instrument panel has standard VFR aero navigation and engine control instruments. Operating is double with possibility to control the aircraft from both seats.



The wing is rectangular with one spar construction supported by spurt over 50% from spread of half wing. The location of rudders is standard. The flaps deflect at three positions 0°, 20°, 40° and 60°. The control of ailerons and elevator is with push-pull cables. For the operation of rudder are used classic steel cables. The controlled trim over the elevator is controlled by electric system.

The landing gear is pyramidal type with elastic cord over ever inside spurt. The wheels are aluminum minimum 6 inches

### ***Presentation of "Aeroplanes DAR" Ltd***

in diameter (max. 8 inches) completed with mechanic drum brakes, inner tubes and tires.

The nose wheel is connected and operated with the vertical rudder.

The tank is in rear part of cockpit (behind seats) with volume 22 liter. The flow of fuel is secured by fuel pump.

MTOW of DAR-23 is 380 kg empty weight 195 kg.

MTOW of DAR-23 enclosed is 400 kg empty weight 215 kg.

## ***PRESENTATION OF DAR-241 AIRPLANE***

This airplane was developed under practical requirements by the customers. As all other airplanes by "Aeroplanes DAR" Co. Ltd, this new project continues the idea for simple, popular and low cost airplane for cross country distances.

The maintenance is quite simple and not pretentious.

In flight airplane show high performance, flying is easy, calm and secure, something very important for long distance flights. Twin engine schema gives the high level of safety.



### ***DESCRIPTION OF THE DAR-241***

DAR-241 airplanes are a four-seat with two ROTAX 912S engine (100 HP) or Subaru EA-82 engine (115 HP).

### *Presentation of "Aeroplanes DAR" Ltd*

All metal construction based on aluminum alloys 6061 and 2024.

The cabin is car type, with large doors from each side. Cabin is wide 120 mm, with excellent panoramic view. The cargo compartments are two, one in nose section and one after rear seat. Belly container is provided as extra equipment to increase the cargo capacity.

The engines are mounted on wings, between rip sections 3 and 4. The propellers are on ground adjustable, but as option are in flight pitch control.

The instrument panel has standard VFR aero navigation and engine control instruments. Operating is double with possibility to control the aircraft from both front seats. Intercom is with four position with head set, for each passenger.



The wing is rectangular with one spar construction supported by spurt over 50% from spread of half wing. The location of rudders is standard. The flaps deflect at three positions 0°, 15° and 30°. The control of ailerons and elevator is with push-pull cables. For the operation of rudder are used classic steel cables. The controlled trim over the elevator is controlled by electric system.

The landing gear is alum spring. The wheels are aluminum minimum 6 inches in diameter (max. 8 inches) completed with hydraulic disk brakes, inner tubes and tires.

The tail wheel is connected and operated with the vertical rudder.



The tanks are in wings with volume 35 litter. The flow of fuel is secured by fuel pump.  
MTOW of DAR-241 is 850 kg.

## ***DAR AIRPLANES SPECIAL AICRAFT AND APPLICATIONS***

### ***AGRICULTURAL***

The Specialized Agricultural Aircraft provides a possibility to choose chemical equipment. Spray systems come in two types: with a rotary atomizer or a direct one. These systems are produced by several companies - American, English, Russian and Ukrainian. Each system has very good specifications for area coverage and fragmentation of crop treatment preparation. There are two big advantages in using such spray systems:

*Presentation of "Aeroplanes DAR" Ltd*



High ecological factor - the high pulverization level of the substance provides better absorption by plants and gives a chance to a very precise dosage and avoidance of surplus amounts. Low speed and spray height ensure exact crop treatment - surrounding area being not affected by scattered, drifted or inaccurately released substance.

Low price - the production costs of aerial application of such a system mounted on DAR AGRAR aircraft starts from \$ 0.45 per hectare. This price makes the combination of DAR-AGRAR and the spray system an indisputable leader in agrochemical activities in Bulgaria.



*Presentation of "Aeroplanes DAR" Ltd*

The disadvantage of these systems - not being able to treat vast areas (about 1000 hectares) - turns into a great advantage in Bulgaria. It is well-known that such areas do not exist in Bulgaria. The aircraft is easily operated and no special runway is needed - thus there is a chance the aircraft to be in immediate proximity to treated crops every day. AG System can be installed on other airplanes from DAR family.



## ***COURIER VERSION***

A courier Company wants to operate light aircraft between big towns in Bulgaria. The load flow and distance analysis determined the parameters of the modified aircraft version for cruise flights. The aircraft will be equipped with a more powerful engine and will ensure an average speed of 200 km/h and a load factor of 200 kg. By operating such aircraft the company desires to offer better courier services when it comes to time, namely to introduce the so called "same day delivery" to Bulgaria. Thus a better service could be offered on the courier service market. DAR-21 Courier gives advantages not only in time but also in price. The company would pay operating costs of the aircraft 0.08EUR/km against 0.6EUR/km by car (calculation is done for Peugeot Partner).





## ***SPECILIZED POLICE AIRCRAFT***

DAR Aeroplanes develop a series of airplanes for specific police work.



The different model cover all necessary needs as highway patrol, coast guard, border police, fire brigades and gendarmerie.



*Presentation of "Aeroplanes DAR" Ltd*



The airplanes are practical for using and the lowest operation and maintenance cost make it very attractive. DAR Police airplanes give advantages not only in time but also in price. The lowest expenses will give opportunity to Police to have several airplanes in position "Ready to action" on different regions of the country

