Operations Manual

Introduction

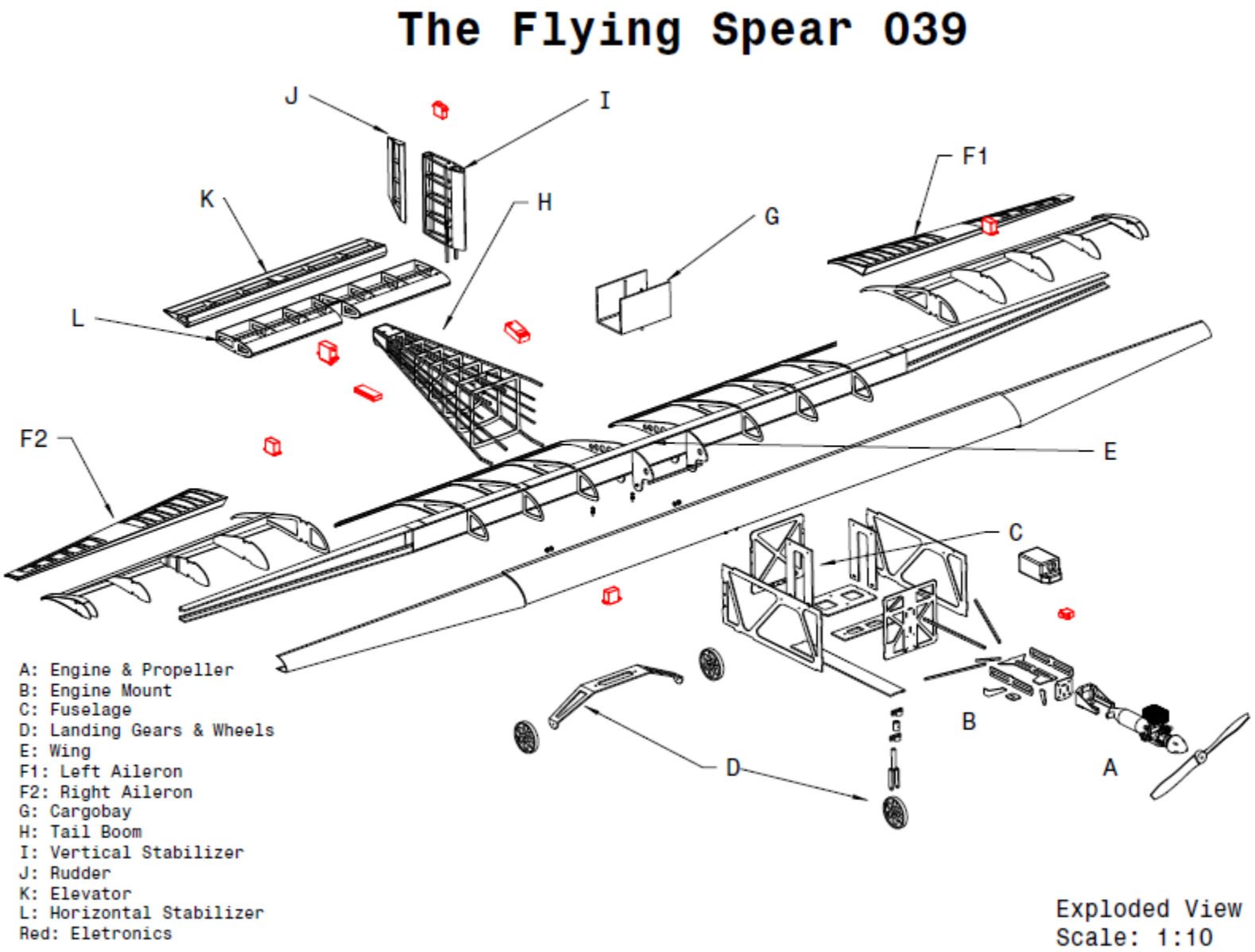
Our aircraft is comprised of five major components: fuselage, wing, landing gear, tailboom, and tail assemblies. The wing contains two control surfaces symmetrically on both sides of the tapered wing section. The tail assembly contains both the horizontal and vertical stabilizers which each have their respective control surfaces: elevator and rudder. The landing gear assembly consists of both a front steering component and main landing gear which is mounted between the CG position and the beginning of the tailboom. The tailboom provides structural continuity between the fuselage and the tail assembly.

The ailerons are operated by their own servo motors mounted on the main wing whose cabling runs along the inside of the wing through the airfoils. Their purpose is to offer roll control when banking into turns. The elevator is controlled by an upside-down servo mounted on the horizontal stabilizer whose purpose is to control the pitch of the aircraft affecting the rate of ascent and descent. The rudder is controlled by a servo mounted internally in the vertical stabilizer. Its purpose is to control the yaw movement of the aircraft which rotates the aircraft about a vertical axis. The remaining servo controls are found in the motor throttle control to adjust the flow rate of fuel for the carburetor mid-flight and the front wheel steering control which gives the pilot steering control at runway conditions.

These servo controls are all routed to a main receiver which is mounted at the rear of the fuselage. The power delivered by a battery mounted in the tailboom is toggled using an on/off switch affixed to the bottom of the fuselage adjacent to the main landing gear assembly. Toggling this switch to the on position activates the servo controls which can then be adjusted when the radio controller is activated and automatically pairs with its receiver.

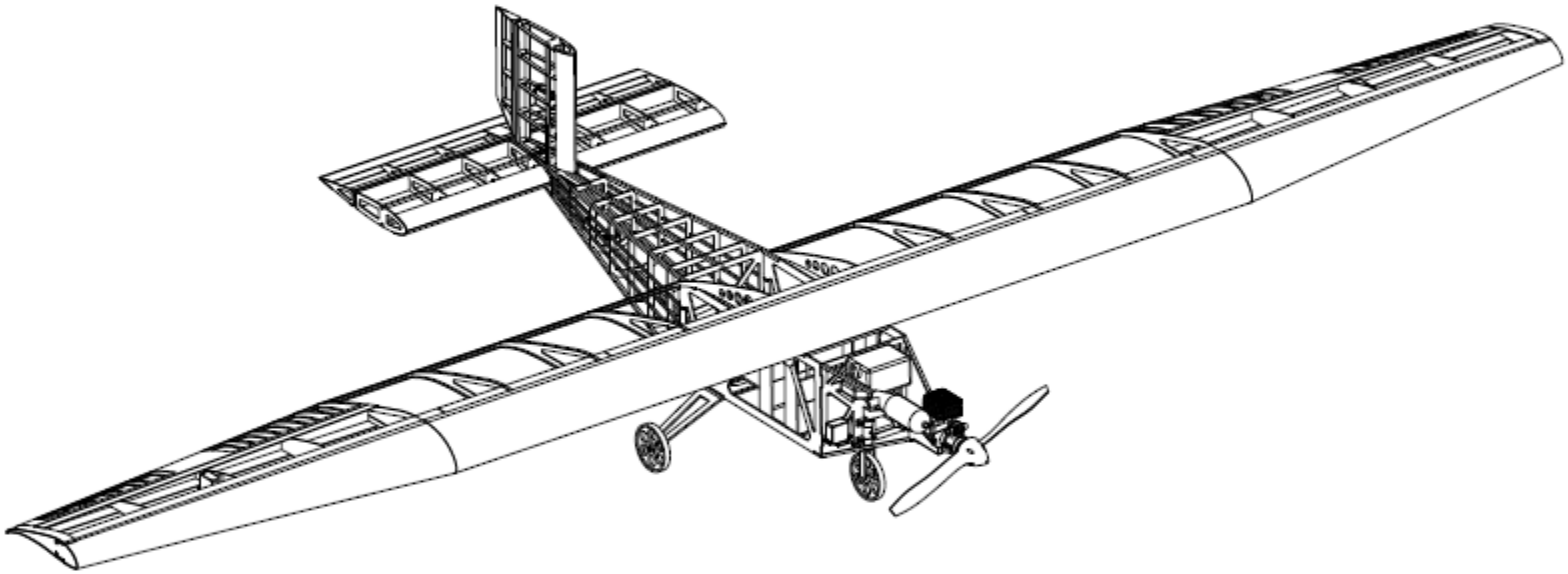
Additionally, because of the competition requirements we do in fact have a cargobay fabricated of steel alloy where the payload for our competition will be attached but this cargobay is not considered as part of the structural integrity of the aircraft.

Exploded View



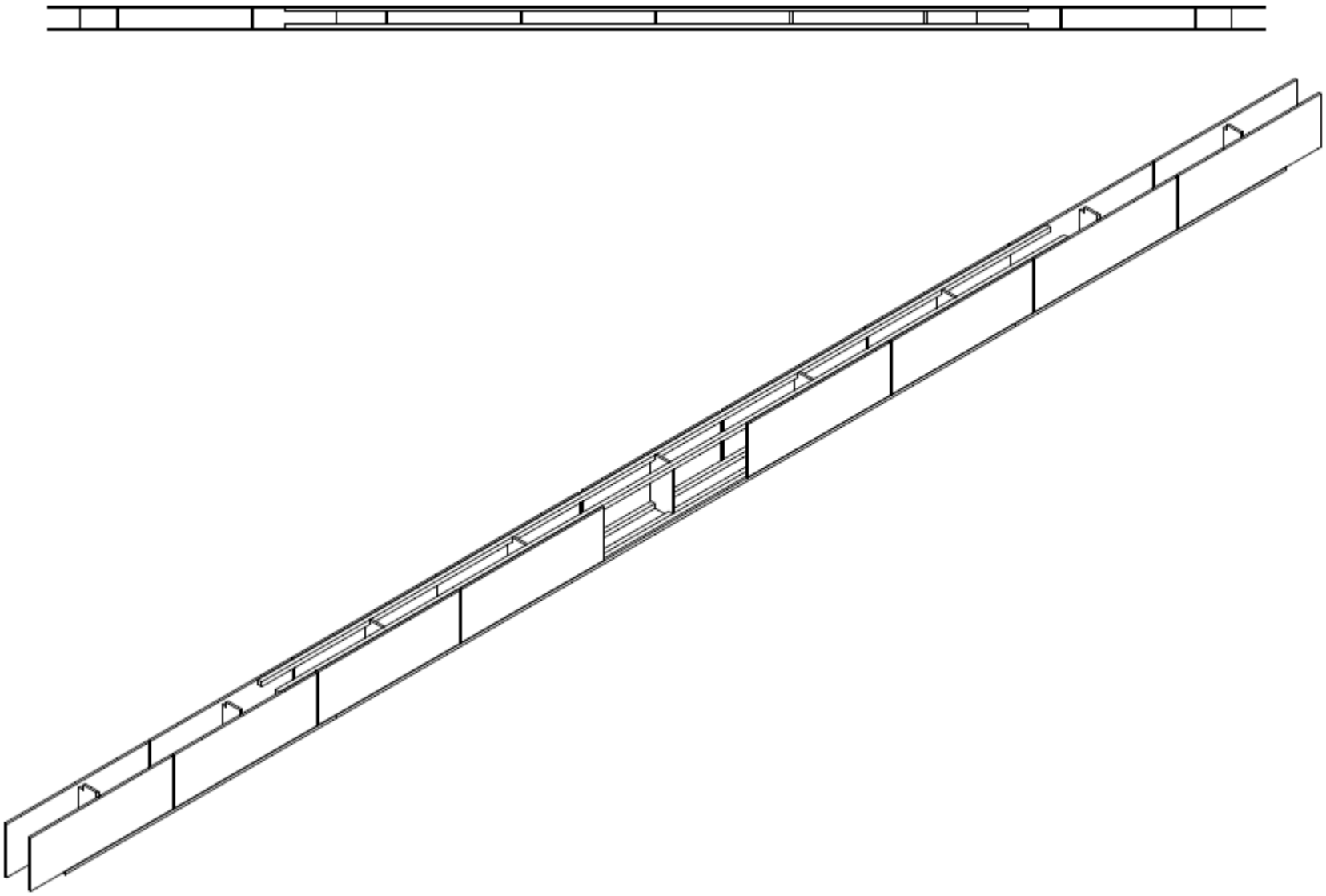
Assembled View

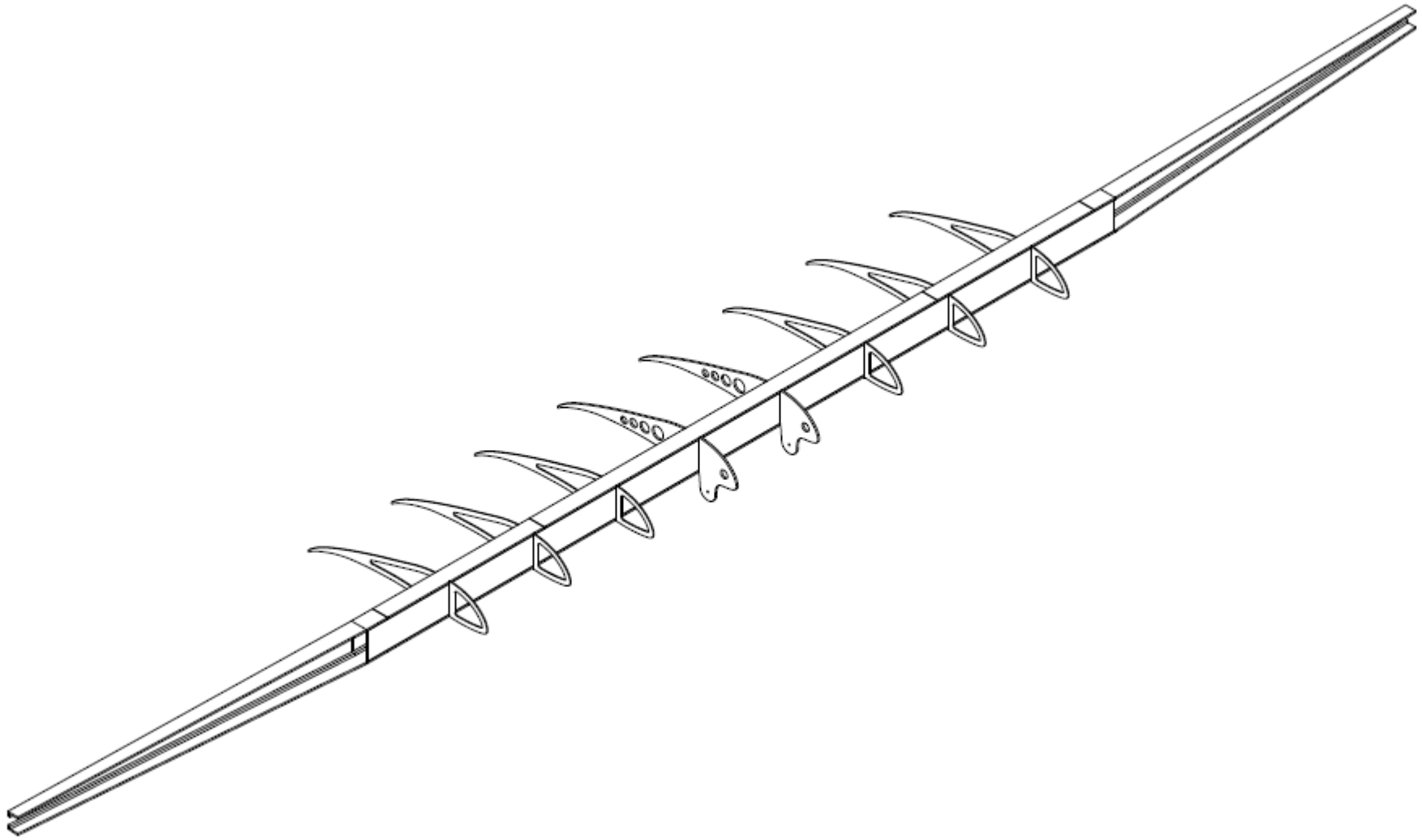
The Flying Spear 039



Isometric View
Scale: 1:10

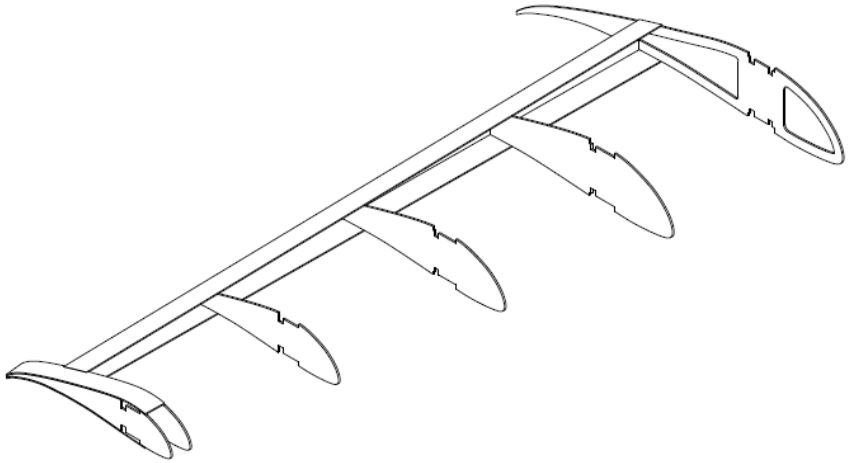
Main Wing Spar



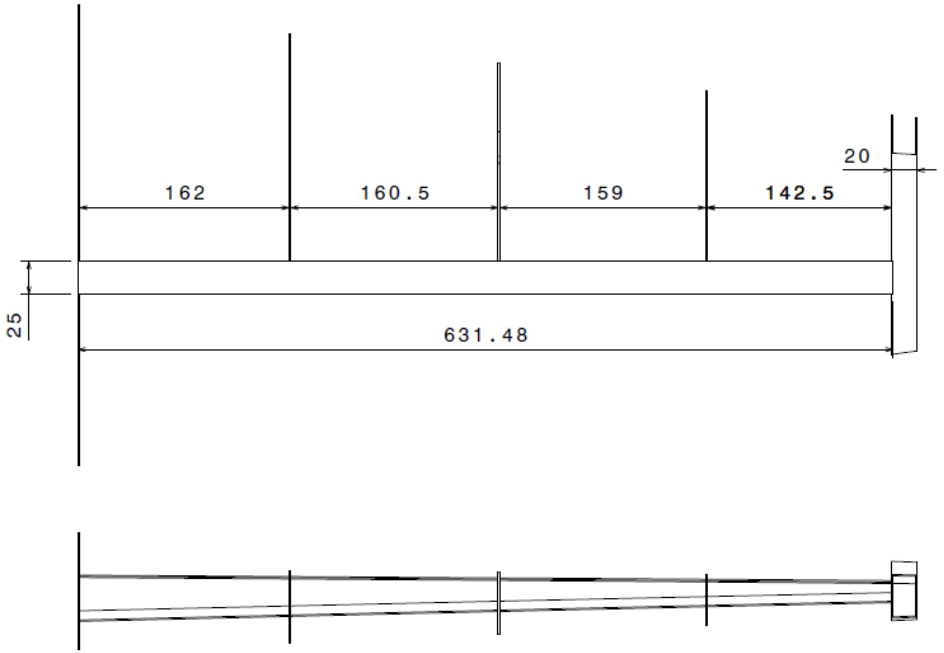


Main Wing

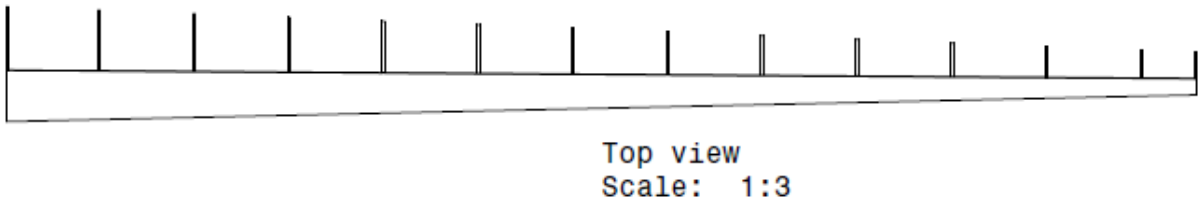
Tapered Wing Sections



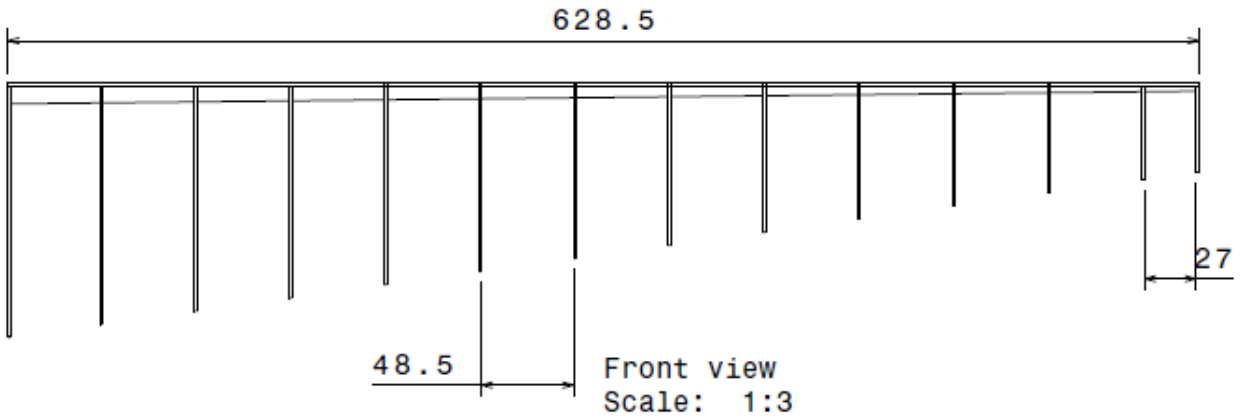
Isometric view
Scale: 1:3



Ailerons

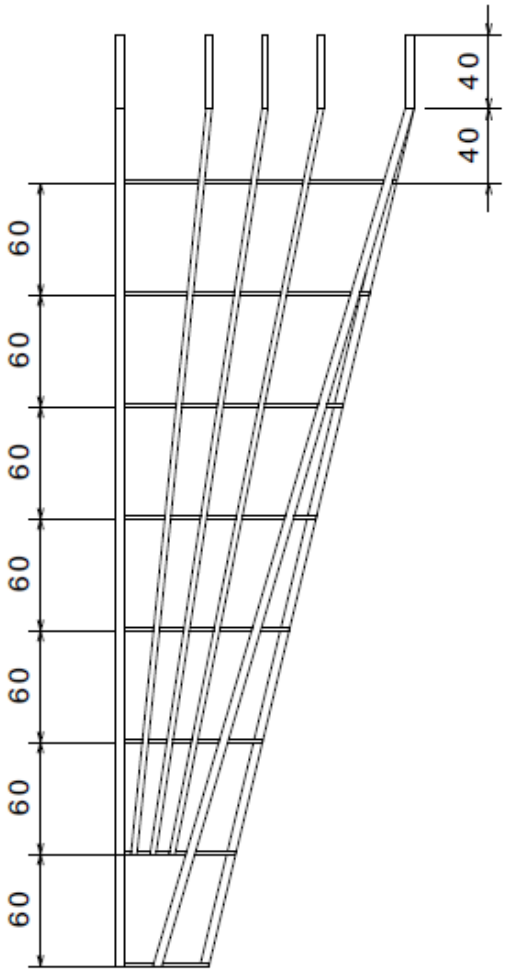


Top view
Scale: 1:3

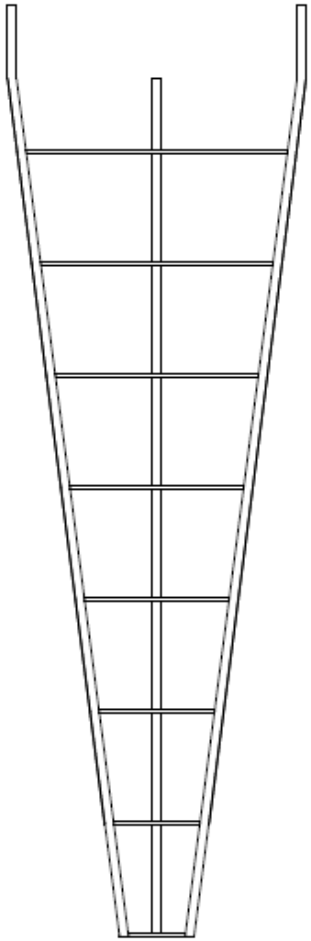


Front view
Scale: 1:3

Tailboom

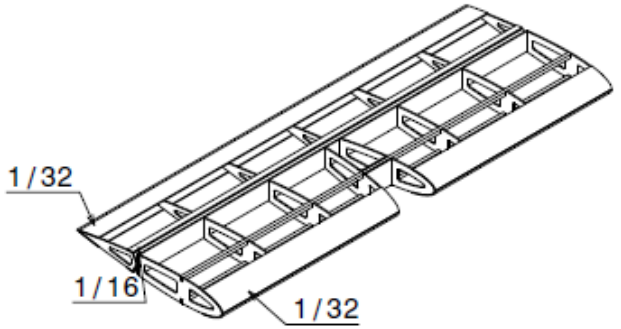


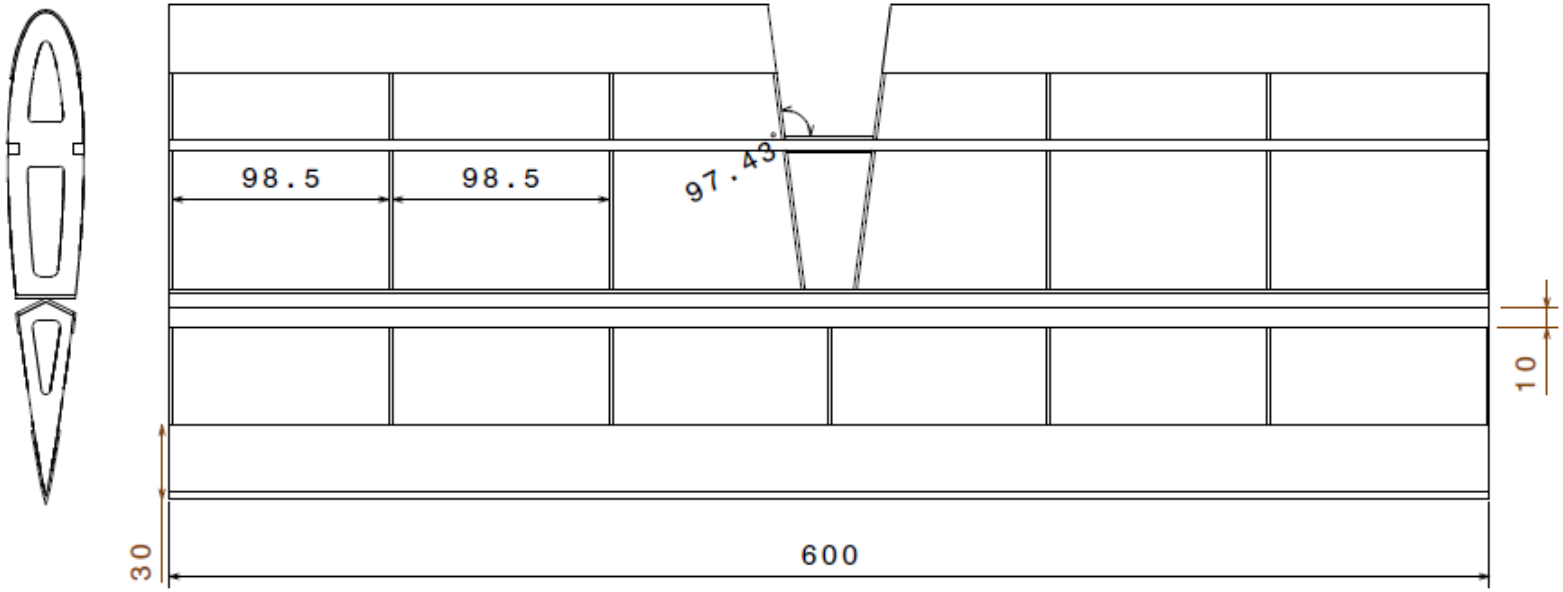
Right view
Scale: 1:3



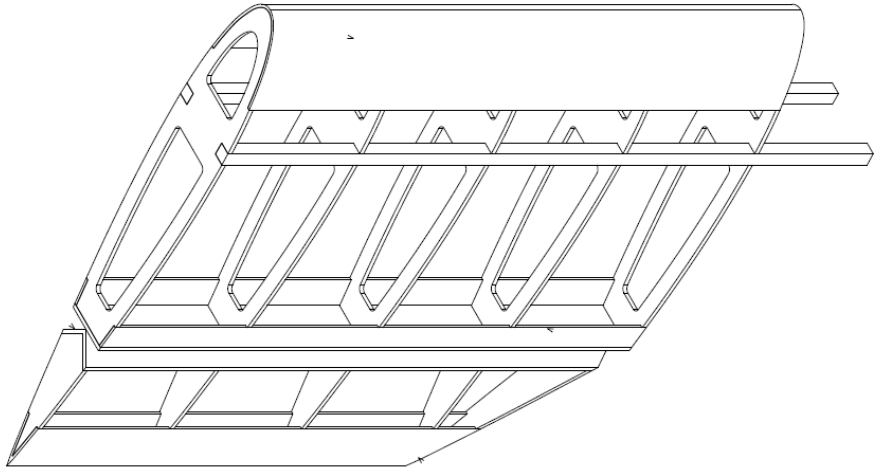
Front view
Scale: 1:3

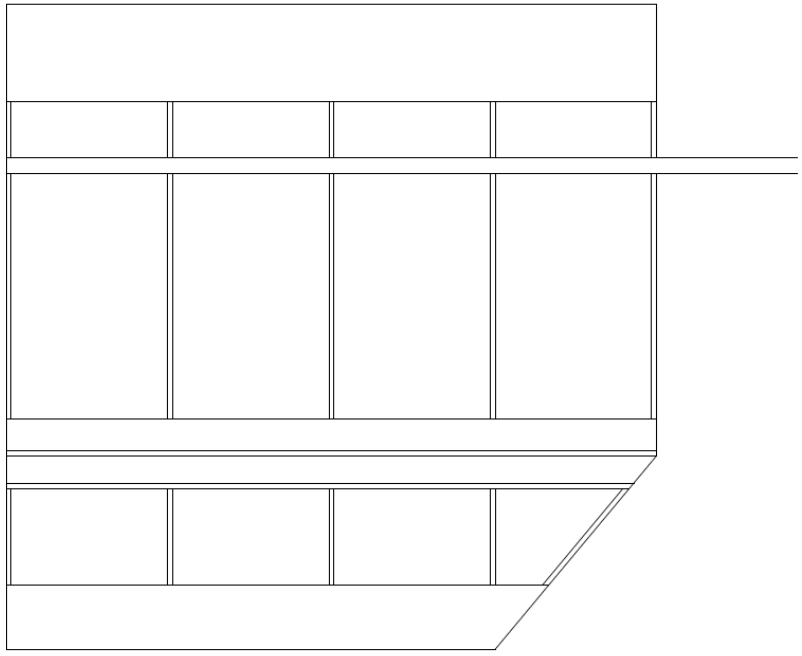
Horizontal Stabilizer





Vertical Stabilizer





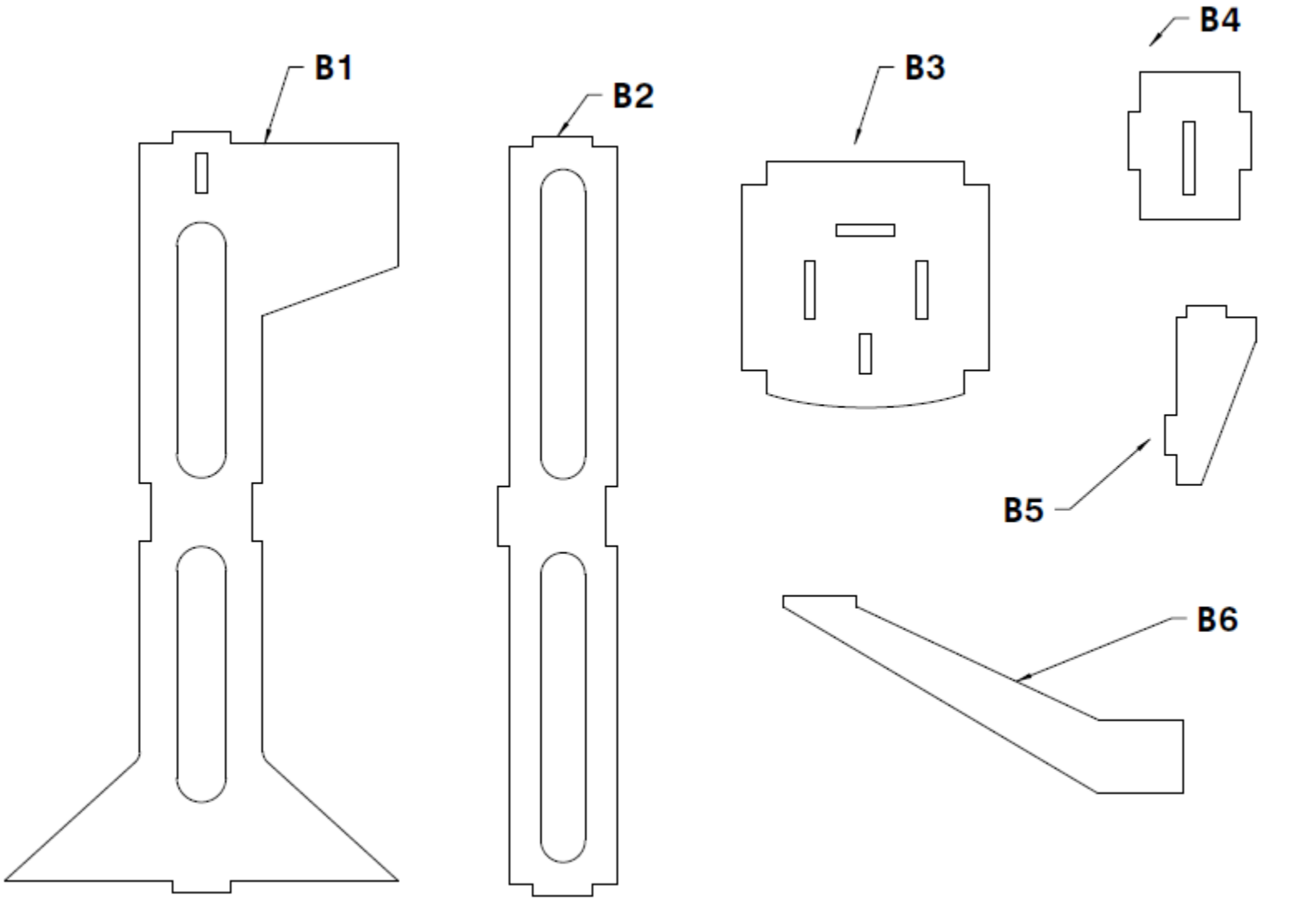
Bill of Materials

Component	Piece	Material	Quantity	Operation
Engine Mount	B1	Plywood 3/32	1	Laser cut
	B2	Plywood 3/32	2	Laser cut
	B3	Plywood 3/32	1	Laser cut
	B4	Plywood 3/32	1	Laser cut
	B5	Plywood 3/32	1	Laser cut
	B6	Plywood 3/32	1	Laser cut
Fuselage	C1	Birch Plywood 1/8	2	Laser cut
	C2	Birch Plywood 1/8	1	Laser cut
	C3	Birch Plywood 1/8	1	Laser cut
	C4	Birch Plywood 1/8	1	Laser cut
	C5	Birch Plywood 1/8	2	Laser cut
	C6	Birch Plywood 1/8	1	Laser cut
	C7	Birch Plywood 1/8	1	Laser cut
	C8	Birch Plywood 1/8	1	Laser cut
Landing Gear	D1	Aluminum 6061	1	Machined
Wheel	D2	Nylon	3	Machined
Steering Wheel	D3	Aluminum 6061	1	Machined
	D4	Nylon	2	Machined
	D5	Nylon	1	Machined
Wing Profiles	E1	Plywood 3.2mm	2	Laser cut
	E2	Balsa 1/16	8	Laser cut
	E3	Balsa 1/16	2	Laser cut
	E4	Balsa 1/16	2	Laser cut
	E5	Balsa 1/16	2	Laser cut
	E6	Balsa 1/16	2	Laser cut
	E7	Balsa 1/16	2	Laser cut
Wing Spar	E8	Balsa 1/16	10	Laser cut
	E9	Balsa 3/32	16	Laser cut
	E10	Balsa 3/32	2	Laser cut
	E11	Balsa 3/32	4	Laser cut
	E12	Balsa 3/32	2	Laser cut
	E13	Balsa 3/32	4	Laser cut
Aileron	F1	Balsa 1/16	2	Laser cut
	F2	Balsa 1/16	2	Laser cut
	F3	Balsa 1/16	2	Laser cut
	F4	Balsa 1/16	2	Laser cut
	F5	Balsa 1/16	2	Laser cut
	F6	Balsa 1/16	2	Laser cut
	F7	Balsa 1/16	2	Laser cut
	F8	Balsa 1/16	2	Laser cut
	F9	Balsa 1/16	2	Laser cut
	F10	Balsa 1/16	2	Laser cut
	F11	Balsa 1/16	2	Laser cut
	F12	Balsa 1/16	2	Laser cut

	F13	Balsa 3/32	2	Laser cut
Tail Boom	H1	Balsa 3/32	2	Laser cut
	H2	Balsa 3/32	2	Laser cut
	H3	Balsa 3/32	2	Laser cut
	H4	Balsa 3/32	2	Laser cut
	H5	Balsa 3/32	1	Laser cut
	H6	Balsa 3/32	1	Laser cut
	H7	Balsa 3/32	1	Laser cut
	H8	Balsa 3/32	1	Laser cut
	H9	Balsa 3/32	1	Laser cut
	H10	Balsa 3/32	2	Laser cut
	H11	Balsa 3/32	2	Laser cut
Vertical Stabilizer	I1	Balsa 1/16	5	Laser cut
Rudder	J1	Balsa 1/16	1	Laser cut
	J2	Balsa 1/16	5	Laser cut
Elevator	K1	Balsa 1/16	6	Laser cut
	K2	Balsa 1/16	1	Laser cut
Horizontal Stabilizer	L1	Balsa 1/16	1	Laser cut
	L2	Balsa 1/16	1	Laser cut
	L3	Balsa 3/32	4	Laser cut

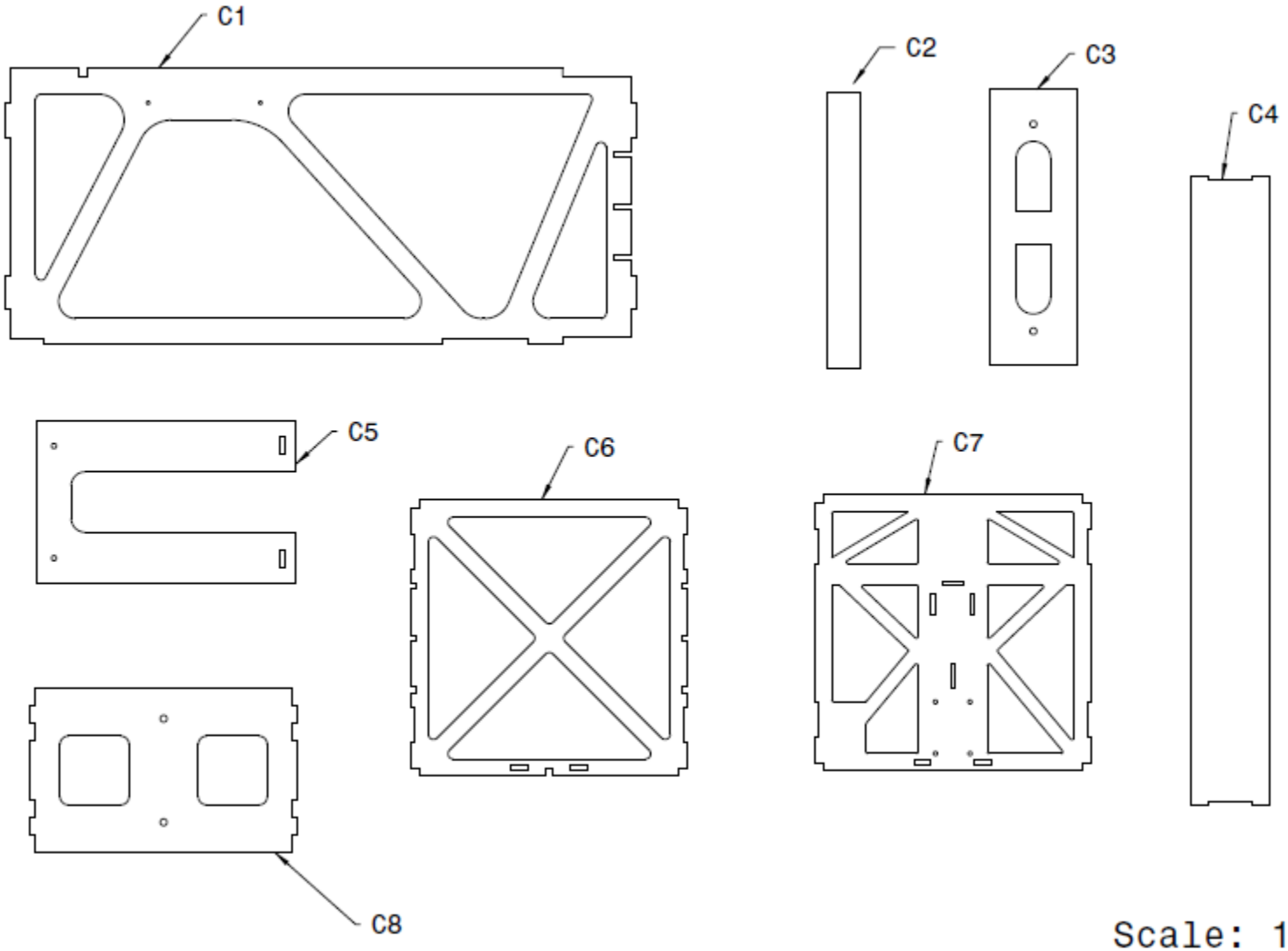
Materials Used			
Product	Price ($)	Quantity	Total
Plywood 3/32x1	22.59	8	180.72
Engine Magnun 0.61	173.17	1	173.17
Balsa 3/32x4x36	2.89	18	52.02
Ultracote	15.99	2	31.98
Balsa 1/8x4x36	3.19	9	28.71
11.1V battery	26.99	1	26.99
Plywood 12x24	22.49	1	22.49
10oz glue	7.39	3	22.17
Gas	16.99	1	16.99
48" servo wire	5.5	3	16.5
6V battery	15.99	1	15.99
pushrod	7.25	2	14.5
5min epoxy	12.99	1	12.99
30min epoxy	12.99	1	12.99
36" servo wire	5	2	10
power switch	7.99	1	7.99
2oz glue	6.99	1	6.99
6oz fuel tank	6.89	1	6.89
9G servo	6.49	1	6.49
servo connect	2.89	2	5.78
Balsa 1/16x4x36	2.59	2	5.18
8oz fuel tank	5.15	1	5.15
Wire harness	5	1	5
13x6 propeller	4.9	1	4.9
clevis nylon	4.79	1	4.79
balsa strip	0.59	7	4.13
Alum Tube	2.99	1	2.99
11x6 propeller	2.86	1	2.86
wood dowels	1.79	1	1.79
thread rod 4x40	1.69	1	1.69
thread rod 2-56	0.65	2	1.3
8pc hex nut	0.85	1	0.85
CS-35 Servo	19.99	3	57.97
CS-64 Servo	22.99	1	22.99
CS-12 servo	21.99	1	21.99
HXT 900 Servo	15.99	1	15.99
Total Money spent			831.92

Engine Mount -B-



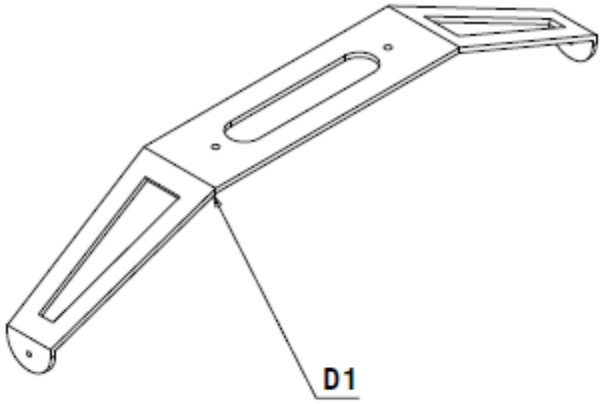
Scale: 1:1

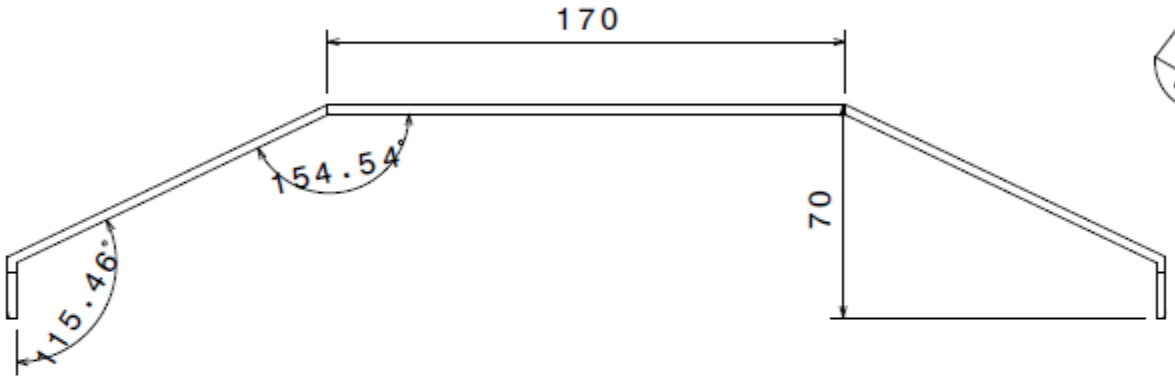
Fuselage -C-

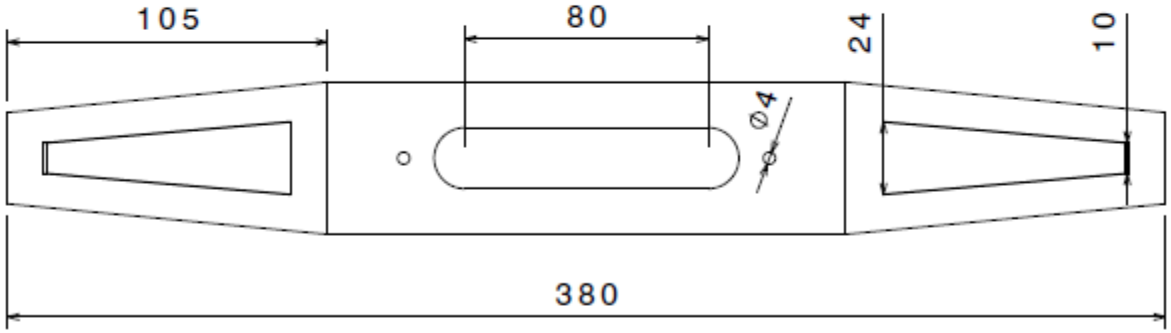


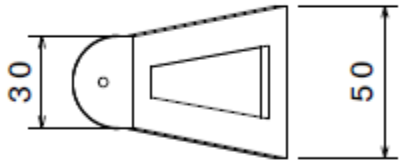
Scale: 1:3

Landing Gear -D-



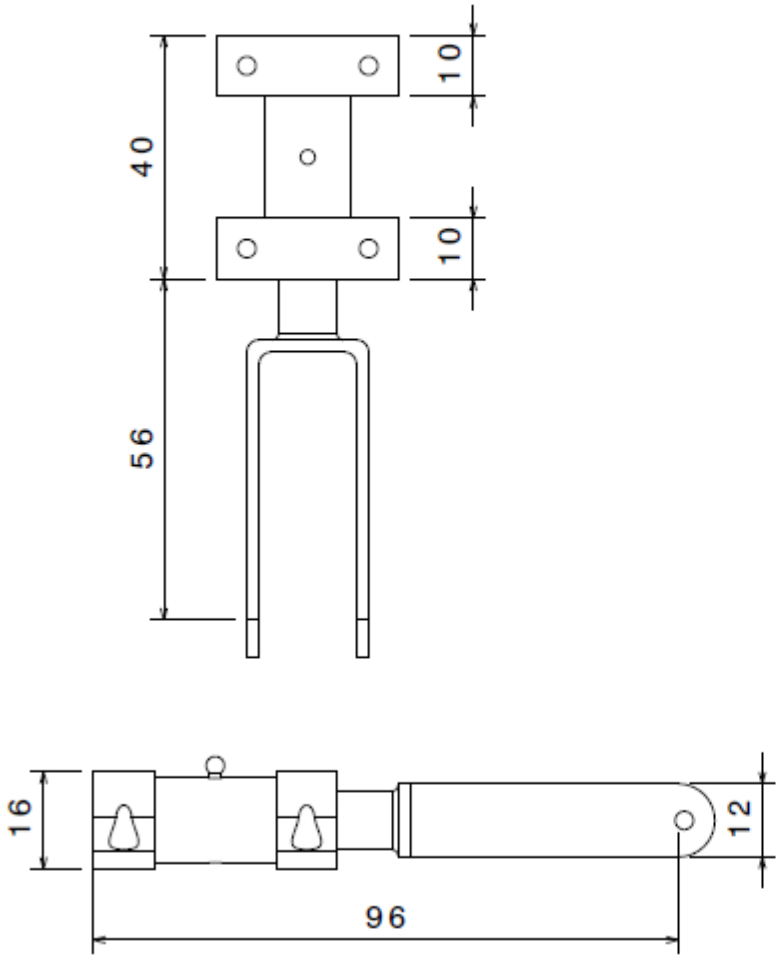


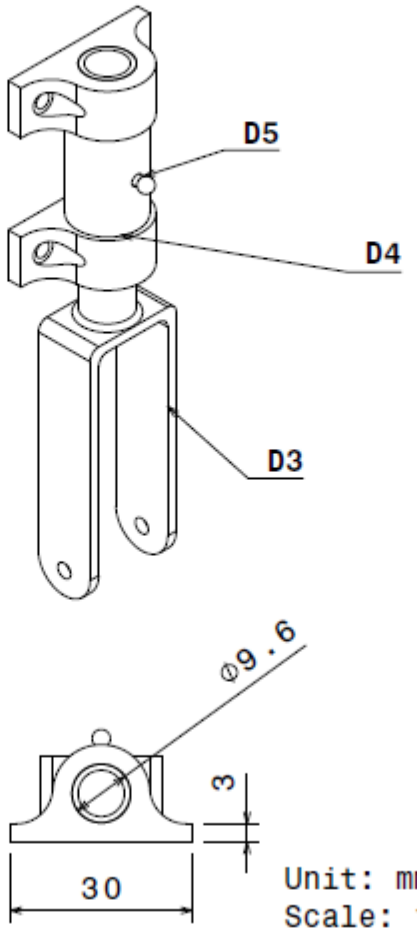




Unit: mm
Scale: 1:2
Component: Landing Gear

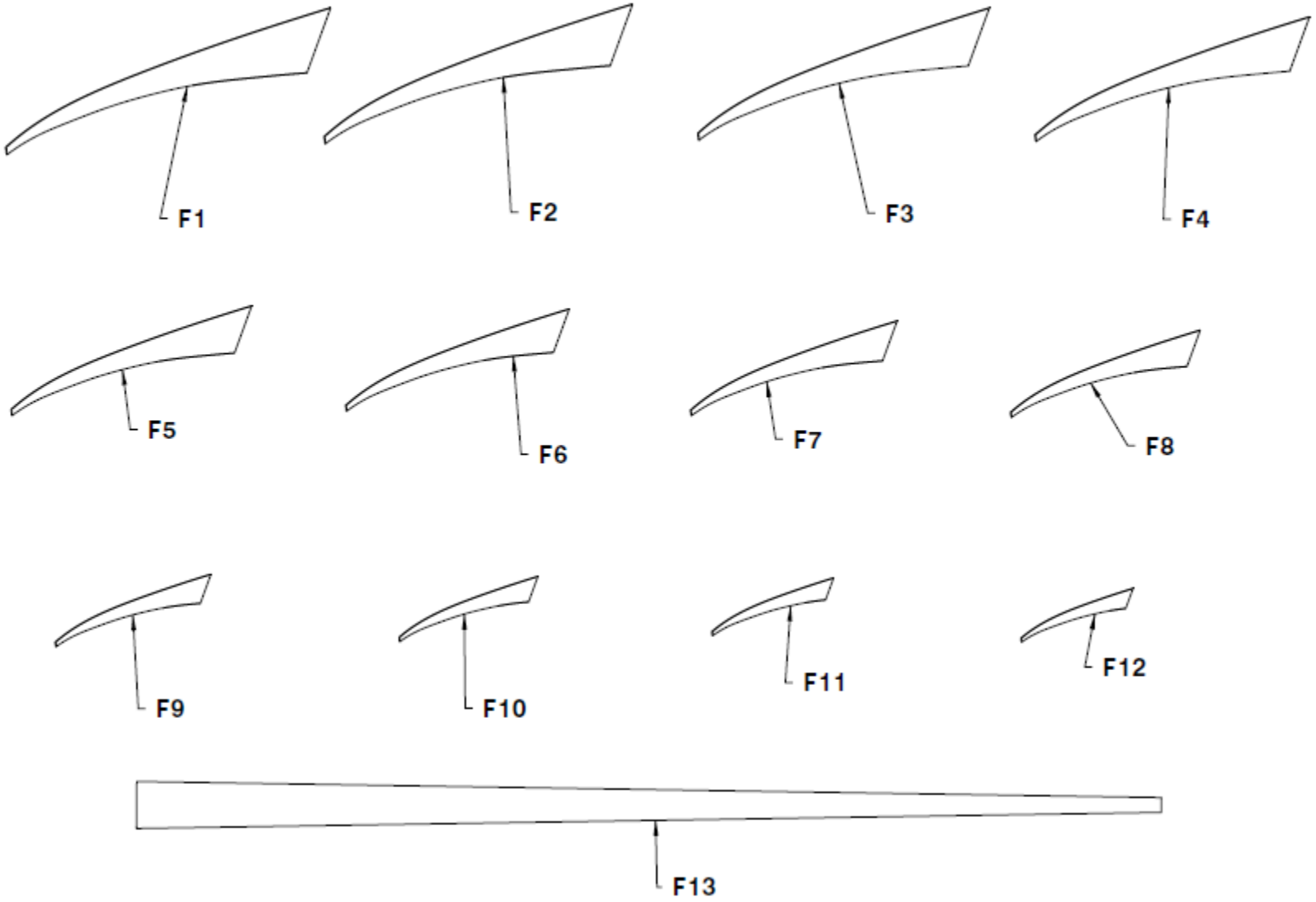
Steerable Wheel **E**





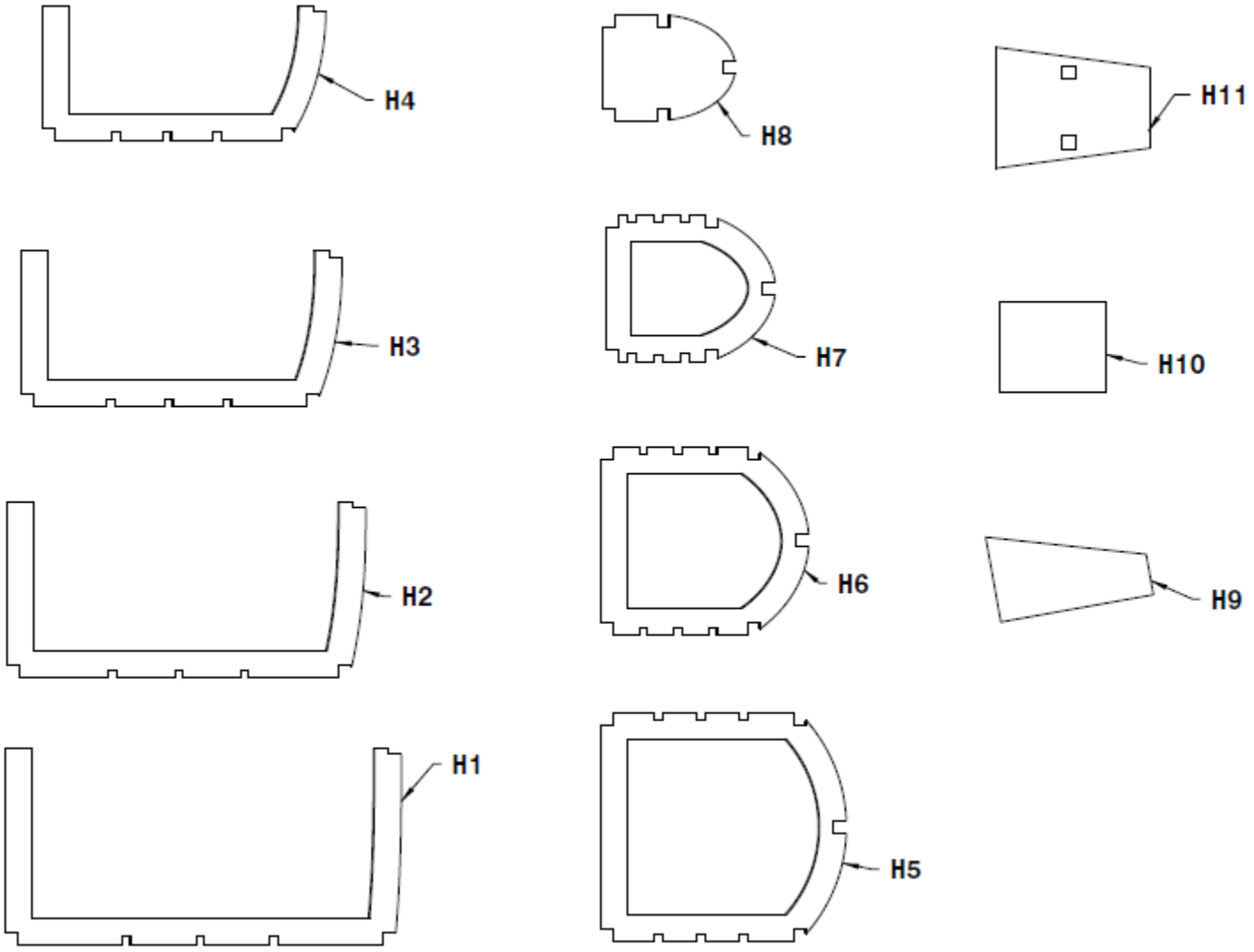
Unit: mm
Scale: 1:1
Component: Steerable Wheel

Aileron -F-



Scale: 1:2

Tail Boom -H-



Scale: 1:2

Hobbico CS-12MG - High-Speed Micro MG Servo

Modulation	Analog
Torque	4.8V: 36.0 oz-in (2.59 kg-cm)
	6.0V: 42.0 oz-in (3.02 kg-cm)
Speed	4.8V: 0.11 sec/60°
	6.0V: 0.09 sec/60°
Weight	0.67 oz(19.0g)
	Length: 1.20 in(30.5 mm)
Dimensions	Width: 0.50 in(12.7mm
	Height: 1.10 in(27.9 mm)
Gear Type	Metal
Rotation/Support:	Bushing

Hobbico CS-64 - High-Torque Standard Servo

Modulation:	Analog
Torque:	4.8V: 69.0 oz-in (4.97 kg-cm)
	6.0V: 83.0 oz-in (5.98 kg-cm)
Speed:	4.8V: 0.18 sec/60°
	6.0V: 0.15 sec/60°
Weight:	1.76 oz (50.0 g)
Dimensions:	Length:1.60 in (40.6mm)
	Width:0.80 in (20.3 mm)
	Height:1.50 in (38.1 mm)
Motor Type:	3-pole
Gear Type:	Plastic
Rotation/Support:	Dual Bearings

Hobbico CS-35MG - High-Torque MG Mini Servo

Modulation:	Analog
Torque:	4.8V: 55.0 oz-in (3.96 kg-cm)
	6.0V: 67.0 oz-in (4.82 kg-cm)
Speed:	4.8V: 0.14 sec/60°
	6.0V: 0.11 sec/60°
Weight:	1.09 oz (31.0 g)
	Length: 1.30 in (33.0 mm)
Dimensions:	Width: 0.70 in (17.8 mm)
	Height: 1.20 in(30.5 mm)
Gear Type:	Metal
Rotation/Support:	Bushing

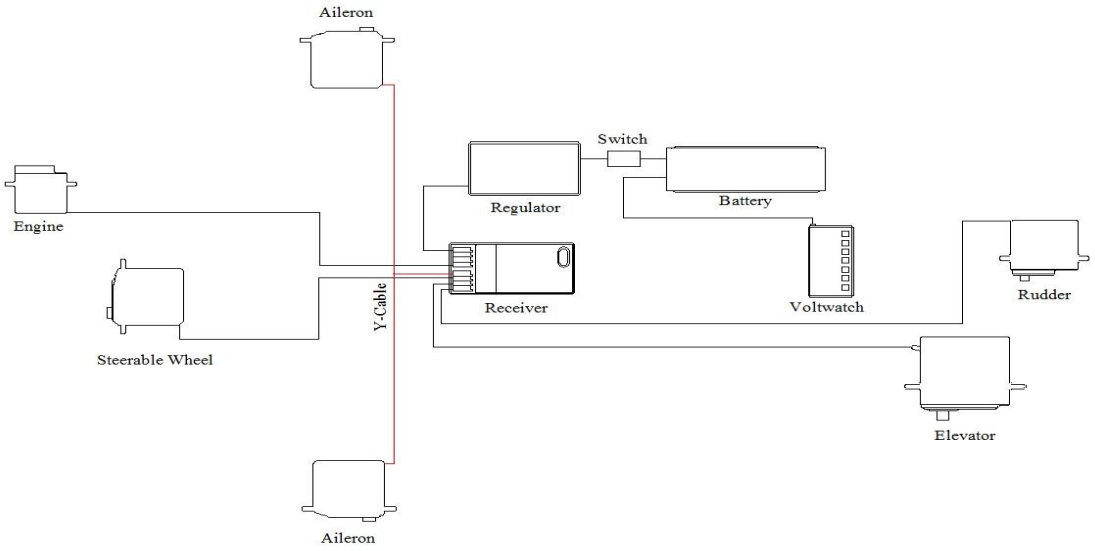
Hextronik HXT900 - 9g Micro Servo

Modulation	Analog
Torque	4.8V: 22.2 oz-in (1.60 kg-cm
Speed	4.8V: 0.12 sec/60°
Weight	0.32 oz (9.1 g
	Length: 0.83 in(21.0 mm)
Dimensions	Width: 0.47 in(12.0 mm)
	Height: 0.87 in (22.0 mm)
Motor Type:	Coreless
Gear Type:	Plastic
Rotation/Support:	Bushing
Rotational Range:	90°
Pulse Cycle:	20 ms
Pulse Width:	450-2450 µs
Connector Type:	JR

AR115 6 Channel DSMX Microlite Spektrum® Receiver

Microlite Park Flyer Receiver	
Modulation	DSM/DSMX
Band	2.4 GHz
Length	1.11 in(28.2 mm)
Width	0.83 in(21mm)
Height	0.39 in(10mm)
Wieght	0.14 oz(4.0g)
Voltage Range	input: 3.5-9.6 V

Circuit Diagram



Fueling and De-Fueling

Fueling is performed by means of a manual pump .

The battery charger equipment must be:

- Specific to the kind of battery utilized;
- Be able to load the battery to be utilized;
- It must have to function to balance the cells individually;

The following list contains battery chargers that may also be used:

- Turnigy Accucel-6;
- e-Station BC6;
- Triton + Equinox Balancer;
- HYPERION charger/ Balancer EOS0606I;
- HYPERION charger EOS 5i dp + HYPERION EOS LBA10 NET BALANCER;
- IMAX B6;

The batteries:

- Must have a connector for the balancing on individual cells;

- Must be accessible, easy to remove and easy to install;

The fuel tank may be changed, however it must possess the following features:

- It must be accessible and visible;
- It should not be opaque(the fuel level can be seen from a relatively safe distance while engine is running);

Engine (Magnum XL .61ª)

The main specs and warnings concerning the engine are highlighted below. The engine manual should be consulted for more details.

ENGINE SPECIFICATIONS

Displacement	9.95cc
Bore	24mm
Stroke	22mm
Practical R.P.M	2,000 - 12,000
Weight (w/Muffler)	21.5oz
Crankshaft Thread Size	5/16 – 24

WARNINGS

Use the recommended size propeller and follow the proper break-in procedure. Inspect the spinner, propeller and propeller nut on a regular basis, looking for any signs of nicks, cracks or loosening. To stop the engine, adjust the throttle linkage to completely close the throttle barrel and therefore cut off the air supply.

INSTALLATION

Muffler Installation

The muffler is mounted to the engine using the two socket cap screws, split washers and one of the two gaskets provided.

Carburetor Installation

Do not over-tighten the retaining nut

Propeller Installation

Before installing any propeller it must be properly balanced.