SM RIM-67A

latest v18.10

PROJECT
Certification LEVEL 3
TRIPOLI ROCKETY ASSOCIATION, INC.

Standard Missile RIM-67A

LUIS IGNOTO LEDO

TRA #14608 - L2

Madrid (Spain) - 2018

Table of Contents pages

1.- General characteristics and Materials

1.1.- Characteristics of the adapted model

Model: Standard Missile RIM-67A

Own construction starting from commercial components.

Structural materials:

Nose cone:	PNC-7.51, high-strenght polyethylene of LOC Precision.
Fuselage:	3 tubes of 30" LOC Precision BT-7.51 laminated with FV and epoxy.
Couplers:	2 of LOC Precision TCL-7.51 laminated internally with FV (fiberglass) and epoxy. One of them adapted as Electronic Bay.
MotorMount tube:	BT-3.00 LOC reinforced with fiberglass and epoxy.
Main fins:	Finnish birch plywood laminated with PV and epoxy.
Longitudinal fins:	Finnish Birch plywood waterproofed with epoxy.

1.2.- General data

Dimensions:	inch	mm
Total length:	112.8	2867
Diameter:	7.71	196
Number of main fins:	4	
Main fins wingspan:	27.95	710
Number of longitudinal fins:	4	
Longitudinal fins wingspan:	12.44	316
Motor mounting diameter:	2.95	75
Aerodynamic resistance coefficient:	0.8	

Motorization:

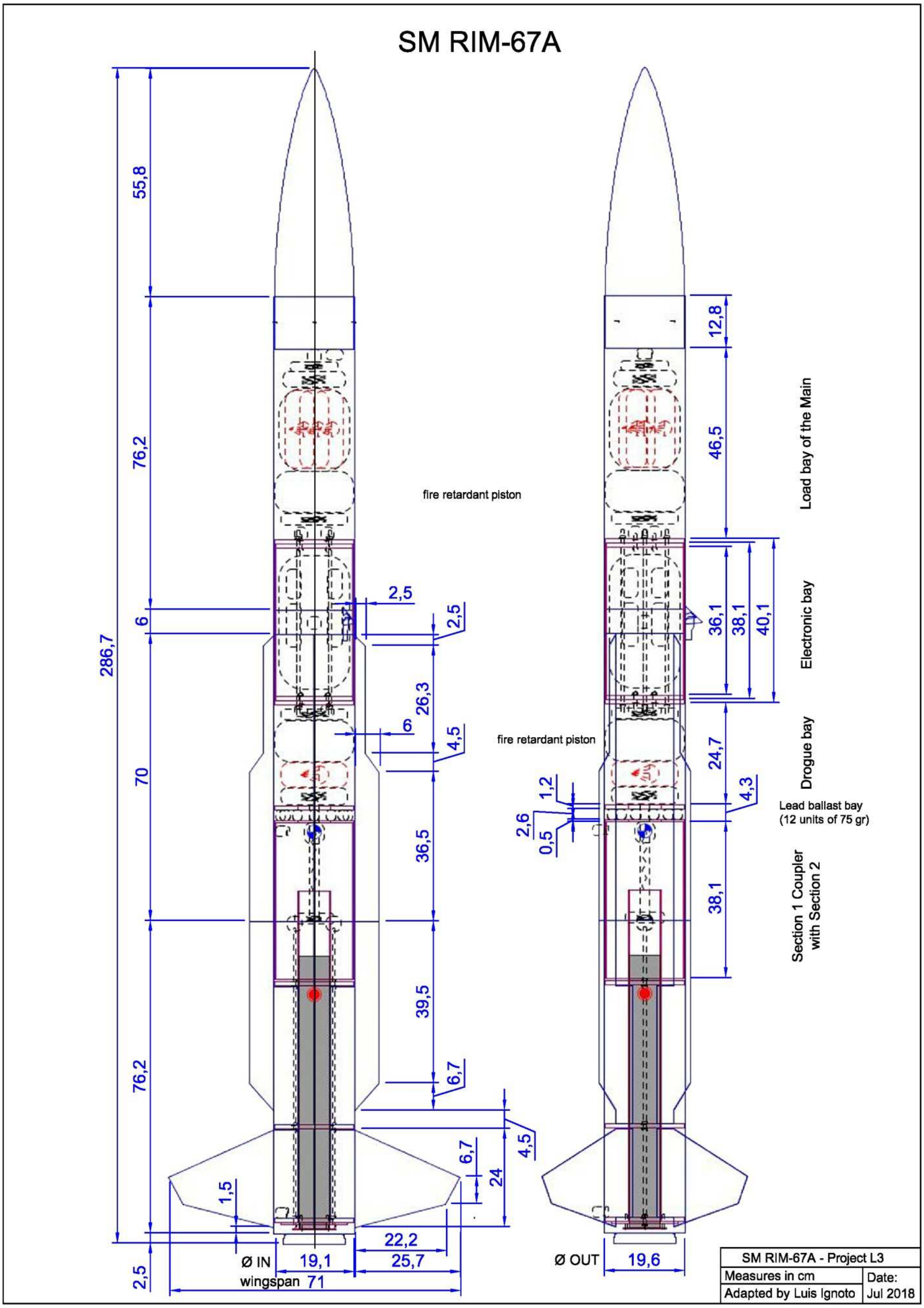
Engine: Manufacturer / Type:	Aerotech / M1297W-P	
Total impulse:	5439 Ns	
Average thrust:	1339 N	
Maximum thrust:	2048 N	
Burn time:	4.06 s	
Total mass:	163.56 oz	4637 g
Mass housing:	67.55 oz	1915 g
Propellant weight	96 oz	2722 g

Weights and performances:

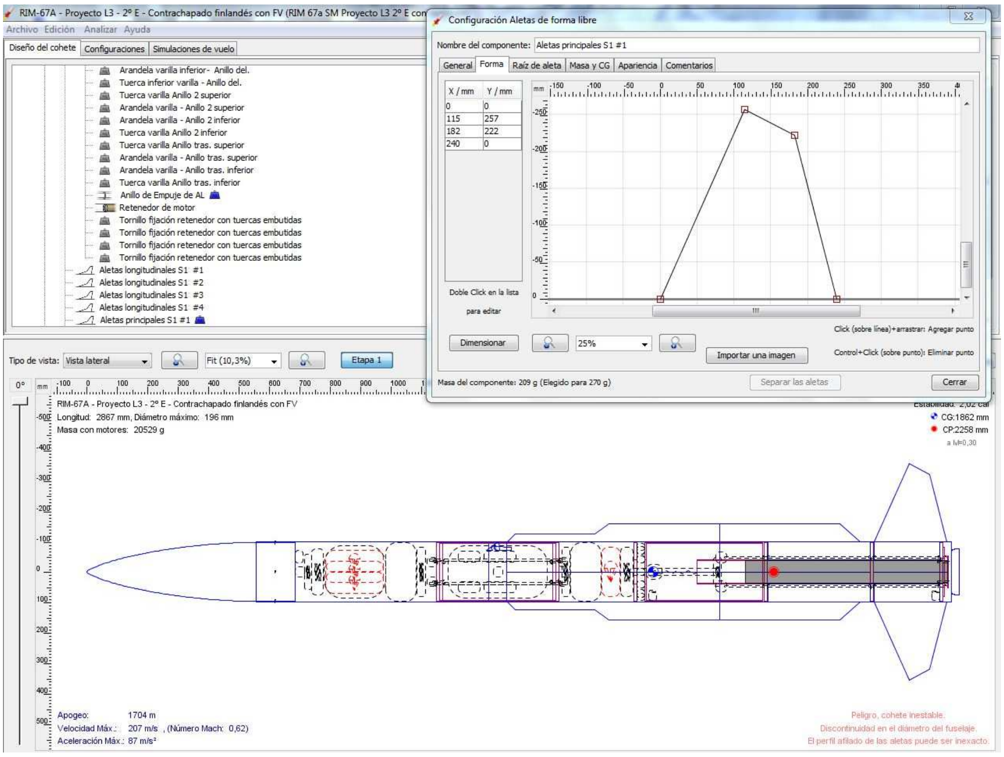
Weight without motor:	15.892 Kg (according to simulator)	
Weight on Pad c / this engine:	20.529 Kg	
Velocity off Pad:	20.1 m/s <> 72.36 Km/h	
Maximum expected Velocity:	207 m/s <> 745 Km/h (Mach 0.62)	
Maximum expected height::	5581 ft	1701 m
Maximum Acceleration:	285.4 ft/s^2	87 m/s^2 <> 8.87 g's
Center of pressure:	89"	2260 mm
Gravity Center for 1 caliber:: < =	81,26"	2064 mm
Center of gravity s / calculations:	73.35"	1863 mm
Stability according to calculations:	2.02	caliber

Missile on which the adaptation is based

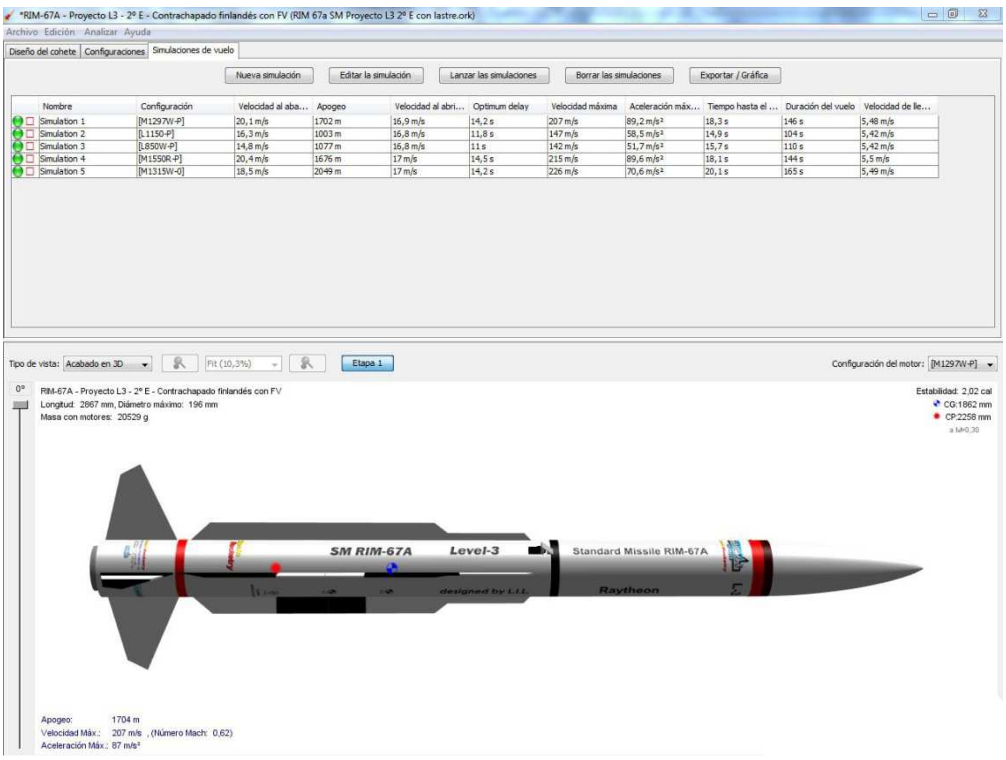
1.3.- Dimensional drawing



1.4 Design and calculations with OpenRocket: Adaptation as SM RIM-67A



The wingspan has been readjusted to ensure a wide range of stability (greater than 1 caliber) resulting in calculations around 2 calibers, including a small mini-DV camera with its fairing.



3D view with paint and decoration and simulation data with different engines with mini-DV camera with its fairing on board.

An OpenRocket design file is included in the attached document. Free software that can be downloaded from: http://openrocket.sourceforge.net/

2.- Background and current participation in Space Modeling

2.1.- Reencounter with Spatial Modelism

After having done Aeromodelling in almost all its facets I started in the Competition Spatial Modeling (CIAM-FAI) in 1977, encouraged by my friend, Angel Infante Moratilla Delegate of this modality in those dates, continuing in the 80s and half of the 90 internationally achieving several successes.
It can be highlighted that at the 4th FAI WSMC-1980 in Lakehurst, NJ, USA with the Spanish Team we won an individual and Team Gold medal in S3A and also a Team Bronze medal in S4D.

I was practicing this Sports-Science from the initial learning, later teaching in the Provincial School to new fans, in the design of models for competition and in the computer programming of an Application for the calculation of stability of the models (adapting it as the computer media advanced). I was Subdelegate of Space Modeling at the CIAM-FAI during the 80s and part of the 90s.

During this time I was managing the Club Grupo Empresa Talbot-RVI, with which we organized competitions for Aeromodelling and Space Model at regional, national and international levels such as a European M.E. in Lleida in 1979 under the direction of the then FENDA - currently RFAE - together with the Club Aeromodelismo Madrileño and the RACBS, and the participation of many sporting friends, particularly Ángel Infante Moratilla, Head of the National Team and Joaquim Gaya (current TRA L3 of our SpainRocketry Club) in the international meetings of Space Model.

Time passed, and I no longer thought I would have the opportunity to practice this hobby again, but my current friend and companion, Jesús Manuel Recuenco Andrés (TRA L2), contacted me through the Internet in January 2011 and invited me to attend a meeting give me to show me his High Power models H.P.R. and launching some low-powered rockets, which incidentally I kept with care including kits not yet built.

In 2011, in February and for that meeting I built an old kit of a small model, the Condor, which carries a lightweight canard glider, I also took my veteran model suitcase and other suitcase, as well as an Maxi ALFA from Estes and others. Jesus Manuel led among others his NOVA-L2, with which I could appreciate the essences of an HPR Space Model.

From there I started to dust and make models, such as an **Interceptor kit of Estes** (which I had not assembled (and I still have a kit for my wife, for our grandchildren).

In the **SRM-2011** of September, which is organized annually by the ***SpainRocketry*** Club, I brought that **Interceptor** to Aerocinca along with a **Space Shuttle** from Estes, already historic and others. But in this meeting I observed and studied everything in detail, photographing everything and all the **HPR** models of all.

In 2012 I applied for registration at CLUB SPAIN ROCKETRY M.E. AEROMODELISME chaired by José L. Cortijos, TRA L2, to whom I thank him for his great welcome, to safely practice this sport-science. This year I went to Fontanar in February where I only launched the **Interceptor** and unfortunately the engine made a CATO.
I had built a custom model of medium power called **NOVA-L0**, from the remains of an old Alfa Maxi Estes along with a Kit that I had left of it, and on the scale of HPR NOVA-L2 Jesus Manuel, but I could not throw it by the adverse weather conditions.
For **June** in Aerocinca I developed a design for altitude, the **PROTO ALT 33.3F** that worked perfectly.
At SRM-2012, which is organized annually by the Club SpainRocketry, I could not attend due to reasons of force majeure.

In 2013, for the May meeting in Velilla de la Sierra, Soria, in addition to low power models, I took the **NOVA-L0** with the 1-phase and 2-phase variants as **NOVA-L0 2E**, as well as a **Weasel 24** totally *custom*, a scale design for D12-5 engine incorporating a mini-DV camera, adaptation based on a model of the companion Rodrigo Borjabad (the Yellow Arrow).
In the **SRM-2013** I decided to take the leap and prepared a model to try the **Level 1 Certification** of TRIPOLI ROCKETRY ASSOCIATION INC .. For which I applied to the Association and with a PML Kit that I purchased from SierraFox, the **QUASAR,** I obtained this **L1 Certification**.

In 2014 I practiced double deployment, both in Derde, Almería and Soria, Velilla de la Sierra, with a custom model, **BETA-2P**, I also designed another one of two diameters, Beta-Cargo, and modified the QUASAR by replacing the original bay of load (of 9 ") by a greater one (of 18") also for double deployment with its parachutes drogue and main, incorporating the corresponding electronics, turning it into the QUASAR Big Bay, that worked correctly.

For the **SRM-2014**, after these tests, I decided to make a model to try the **L2 CERTIFICATION** of TRIPOLI ROCKETRY ASSOCIATION INC., So starting from a fiberglass Apogee Components KIT, the ***Level 2***, which I converted; I cut the profile of the fins, I incorporated some longitudinal fins, I equipped it with electronics, etc (all verified with the OpenRocket Simulator), creating a model inspired by the **Standard Missile RIM-66 SM-2MR**, with which I obtained the **CERTIFICATION L-2**.

<u>In 2015</u> I built a **Black Brant X** of Ø3" with *double deployment*, basically custom except for the motor mount tube, centering ring and Nose Cone.

That same year I made a Ø3" **INTERCEPTOR** on a larger scale with double deployment, also custom except the Nose Cone (based on the old Estes Kit), which was launched at **SRM 2015** in Alcolea de Cinca, Spain.

<u>In 2016</u> I built an **ALARM prototype** of diameter 2.56" basically custom for H engine and that I tested with a G75J in the **SRM-2016** in Aerocinca.

<u>In 2017</u> I developed a **CanSat Cargo prototype** also basically custom as a development of a carrier rocket of 2 CanSat and that I launched in the April meeting of the Club in **El Lantisco, Almeria**, with special success.

And in May at the **RMS-2017** meeting held in Velilla de la Sierra, Soria with the **QUASAR Big Bay** I reached the first "thousand (meters)", 1145 m. (3756 ft). In the **SRM-2017** in Alcolea de Cinca I repeated another "thousand (meters)" with the **Black Brant X**, 1139 m (3737 ft).

<u>In 2018</u> I have made another Cansats carrier for the Club, the CANSAT SR-UPC, at the request of the Polytechnic University of Catalonia, using a modified PML Ariel Kit like the one we already developed for the Yebes City Council, and that we tested in a new field, El Ejido in Aldeacentenera, Caceres, Spain.

In these years and until now I have made a total of 63 launches, of which **33** have been of **Medium and HIGH power**, with a total weight thrown with these of **49789 gr** and a Total Impulse accumulated of **7585 Ns.**

2.2.- **Release history** (stage 2011-2018)

MODELISTA: **LUIS IGNOTO LEDO, TRA #14.608 L2** — *Club* *Spain Rocketry*

Historial de lanzamientos de Cohetes HPR desde 2011 - (En MEDIA y ALTA POTENCIA excluxivamente)

CAMPO: Lugar/Evento	Fecha	Cant.	ROCKET	PESO - gr	MOTOR	MARCA	RMS	SU	Ø	I.T. - Ns	N/Kg	Alt.Estim. m	Observaciones
Aerocinca SRM 2011	9a11 Sep 2011	1	SPACE SHUTTLE	172	C6-5	Estes		X	18	10		70	Altitud simulador - R. Paracaidas
		2	INTERCEPTOR Estes	126	C6-5	Estes		X	18	10		170	Altitud simulador - R. Paracaidas
Aerocinca Social 2012	17_Jun 2012	3	PROTO ALT 33.3F	80	C6-5	Estes		X	18	10		220	Custom. Prototipo de Altitud - R. Paracaidas
Velilla de la Sierra SORIA - RMS 2013	11-12 May 2013	4	NOVA-L0	332	D12-3	Estes		X	24	16,8		90	Modelo custom una Etapa, 1er vuelo.
		5	NOVA-L0 2E	380	D12-0 + D12-5	Estes		X	24	33,6		212	Modelo custom con dos etapas, 1er vuelo.
		6	WEASEL 24	193	D12-5	Estes		X	24	16,8		205	Modelo custom, cámara a bordo. 1er vuelo con motor D
Aerocinca SRM 2013	6a8 Sep 2013	7	QUASAR (L1)	1.514	H165 R	Aerotech	X		29	165		392	Vuelo **CERTIFICACIÓN L1**- Con AltimeterOne.
DERDE Almeria	18a20 Abr 2014	8	BETA-CARGO	684	F40-7W	Aerotech	X		29	80		400	Mod. Custom, estreno. Altitud simulador - R. Paracaidas
		9	BETA-2P	936	G79W	Aerotech	X		29	107		412	Mod. Custom, estreno. Doble D. Altim. SR Alt + AltimeterOne
Velilla de la Sierra SORIA - RMS 2014	17-18 May 2014	10	BETA-2P	945	G77R	Aerotech	X		29	104		420	Doble D. Altim. SR Alt + AltimeterOne (Custom)
		11	QUASAR Big Bay	1.900	H123W	Aerotech	X		38	230		481	Bahia de carga de 18". Doble D. Altim. SR Alt + AltimeterOne
Aerocinca SRM 2014	5a7 Sep 2014	12	BETA-2P	922	G64W	Aerotech	X		29	115		478	Doble Despliegue Altim. SR Alt (Custom)
		13	RIM-66 SM-2MR (L2)	4.692	J275W	Aerotech	X		54	774		815	**CERTIFICACIÓN L2**. Doble Despliegue Altim. SR Alt.
		14	SATURN V	407	E18W-4	Aerotech	X		24	40		193	Maqueta Estes 1974
		15	NOVA-L0	347	E18W-4	Aerotech	X		24	40		250	AltimeterOne a bordo
Velilla de la Sierra SORIA - RMS 2015	16-17 May 2015	16	NOVA-L0	346	E18W-4	Aerotech	X		24	40		250	AltimeterOne a bordo
		17	BLACK BRANT X (3")	2.000	H128W	Aerotech	X		29	175		202	Mod. Custom, estreno. Doble desp. Altim. SR Alt
Aerocinca SRM 2015	4a6 Sep 2015	18	INTERCCEPTOR KL	2.600	I-161w	Aerotech	X		38	334		510	Custom, mayor escala del Estes. Doble despl. Altímetro SRAlt
		19	BLACK BRANT X (3")	2.285	I-211W	Aerotech	X		38	440		830	Restaurado. Auto-construido. Doble despliegue altímetro SRAlt
		20	BETA-2P	1.001	H-128W	Aerotech	X		29	175		735	Doble despliegue altímetro SRAlt. CATO de motor
Aerocinca SRM 2016	2a4 sep 2016	21	ALARM	1.210	G-75J	Aerotech	X		29	155		430	Protoptipo. Drogue sale portezuela a popa. D. Despliegue. AltiDuo
		22	RIM-66 SM-2MR	4.794	J-275W	Aerotech	X		54	819		770	Doble Despliehue. Altimetro SRAlt
		23	INTERCEPTOR KL	2.855	I-284W	Aerotech	X		38	590		812	Mod. Custom repro mod Estes. Doble despliegue. altímetro SRAlt
El Lantisco Almeria	14a16 abr 2017	24	BETA-CARGO	665	F30-FJ6	Aerotech		X	24	45		170	Altitud simulador - R. Paracaidas
		25	CanSat Cargo Prototype	2.872	I211W	Aerotech	X		38	440		678	Doble despliegue SRAlt 2 CanSata de370 gr
		26	BETA-2P	982	G53FJ-7	Aerotech	X		29	91		292	Doble D. Altim. SR Alt (Custom)
Velilla de la Sierra SORIA - RMS 2017	13-14 May 2017	27	NOVA-L0	388	F12-5J	Aerotech	X		24	43		245	R. paracaidas por eyección motor
		28	QUASAR Big Bay	2.067	I211W	Aerotech	X		38	440		1145	Dual deploy. Altim. SR Alt. Con cámara
SRM-2017 Aerocinca	8-9-10 Set 2017	29	NOVA-L0	386	F12-5J	Aerotech	X		24	43	42,5	77	R. paracaidas por eyección motor
		30	ALARM	1.233	G-75J	Aerotech	X		29	155	70	322	Custom. Drogue sale por popa. D. Despliegue. Altimetro SRAlt
		31	BLACK BRANT X (3")	2.515	648J285-15	Cesaroni	X		38	648	121	1139	Auto construido. Doble despliegue. Altímetro SRAlt
El Ejido -2018 Aldeacentenera - CC	29-30 Abril 2018	32	CANSAT SR UPC	3.270	I-161W	Aerotech	X		38	350	49	281	Estreno. Test de vuelo. Con 740 gr de Simil 2 Cansat
		33	RIM-66	4.690	J-275W	Aerotech	X		54	850	59	786	Doble D. Altim; SRAlt. Test de apertura de 3 paracaidas

LANZAMIENTOS EN TOTAL: 33 PESO TOTAL: 49.789 gr IMPULSO TOTAL: 7.585 Ns

2.3.- HPR models more representative made:

2013, Set **QUASAR - Ø2.5", Certification L-1**, L=56.38" (1432 mm), W=55.27 oz (1567 gr).

- -

2014, May **QUASAR Big Bay - Ø2.5"**, L=65.51" (1664 mm), W=72.42 oz (2053 gr), 18" Pay Load Bay, experiencing double deployment

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2014, Set **RIM-66 SM-2MR - Ø4" - Certificación L-2**, L=68.07" (1729 mm), W=165.5 oz (4692 gr), double deployment.

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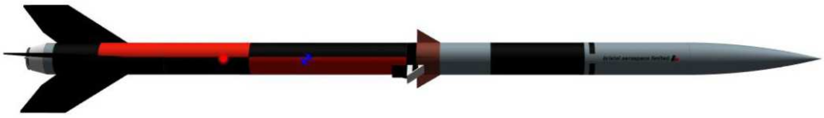


2015, May **BLACK BRANT X - Ø3"**, L=78.94" (2005 mm), W=82.43 oz (2337 gr), double deployment (*custom* except the Nose Cone).

- -

2015, Set **INTERCCEPTOR KL - Ø3"**, L=73.11" (1857 mm), W=102.36 oz (2902 gr), double deployment. (Upper Scale model of the 1980 Estes Kit - custom except the Nose Cone)

- -

2016, Set **ALARM prototype – Ø2.56"**, L=44.6" (1133 mm), W=40.18 oz (1139 gr), Drople ejection by stern door. Double Deployment AltiDuo (custom except the Nose Cone).

- -

2017, Apr **CanSat Cargo prototype – Ø3"**, L=60.24" (1530 mm), W=109.95 oz (3117 gr). Double Deployment. Payload for 2 CanSat (custom except Nose Cone).

- -

2018, Apr **CANSAT SR UPC – Ø3"**, L=67.09" (1704 mm), W=115.34 oz (3270 gr). Double Deployment. Payload for 2 CanSat (Modified Ariel Kit).

- -

3.- Construction of the Standard Missile RIM-67A

3.1.- Choice of material

Since the model I made for the Level 2 Certification was a RIM-66 single-stage missile, based on the redesigned Apogee Components Level 2 Kit, which flew perfectly, I decided to repeat a similar model for this **L-3 Certification.**

Components: FUSELAJE.
With the idea of starting commercial components and looking for an economic cost within my reach, I found in a European supplier the components that are shown in the attached photo that are from the manufacturer **LOC Precision.**

So starting from these components I developed with the OpenRocket program a scaled version of the model indicated and that was adjusted to these components.

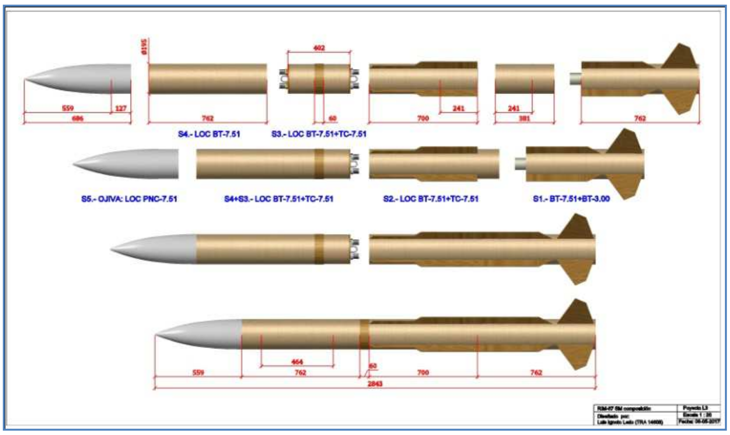
Since the material would not be strong enough, the fuselage and the motor mount tubes will be laminated with Fiberglass and epoxy.
It is considered that 2 layers of 166 g/m2 plus another thin layer of 25 g/m2 as final finish for Section 4 (Main) and 3 layers of 166 g/m2 for the other lower sections will be sufficient.

The fuselage has lengthened a bit in relation to the scale to ensure greater stability.

3.2.- Main fins:

They will be made in Finnish birch plywood of 5.5 mm thickness, 10 layers, with aerodynamic edges and laminated with a PV layer of 166 g / m2 and epoxy resin.
The **longitudinal ones** also in the same material waterproofed with epoxy rexin.
In addition, some spacing ribs will be placed following the vertical of the roots of the fins to reinforce the push zone.

3.3.- Components and structure.



Motor mount tube

The Ø3" motor mount tube will also be reinforced with two **layers of fiberglass fabric of 166 gr/m2 from the house Feroca** and that will focus on the fuselage tube Ø195 mm with centering rings of birch plywood 10 mm thick glued with 30'epoxy.

This has to withstand the maximum thrust of the engine, which reaches 2048 N (209 Kg). This thrust will be transferred to the fuselage and rest of the model through centering rings, the roots of the fins and other internal reinforcements.

Fuselage

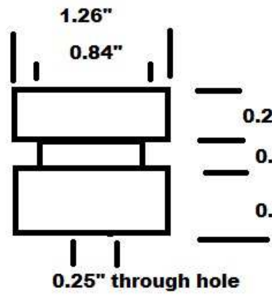
The 3 bodies that will make up the Fuselage will be laminated with 3 layers of the aforementioned 166 g/m2 Glass Fabric and EPOFER Epoxy Resin EX 401/E416 from the special Feroca house for laminates. Likewise, the couplers will be laminated inside with 2 layers of the same material.

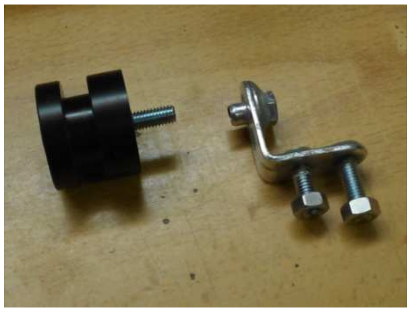
3.4.- Rail buttons

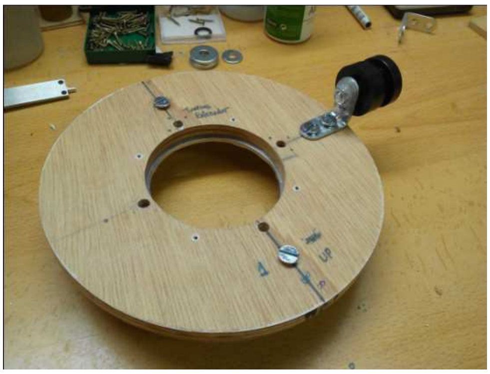
Specific buttons of Ø0.84" (21.3 mm) for rail Unistrut Style marketed by:
http://aeroconsystems.com/cart/launch-and-recovery-accessories/rail-button-unistrut-style-each/

For the fixing of the **bottom rail Button**, a pre-crushed nut of these will be used, which will be fixed on a bracket mechanically coupled and epoxy bonded. On this will be fixed another nut-washer as a lock nut. The neck of this will pass through the fuselage of Section 1 through a hole to be coupled with the Button (which will be drilled 3 or 4 mm to the diameter necessary for it to enter the neck of the nut) fixing it with an M6 screw.. On the other side of the bracket, two M6 screws will be fastened to screw the assembly in turn to the lower thrust ring of Section 1.
Later, the corresponding assembly will be displayed.

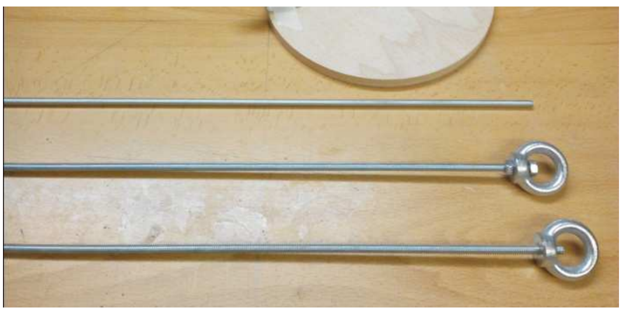
For the **upper rail Button**, another nut with a counter nut will be used, which will fit directly through the wall of Section 2, in the final internal area of the coupler with Section 1, which will give a double wall that will increase the resistance of the same, later will be reinforced with epoxy putty.







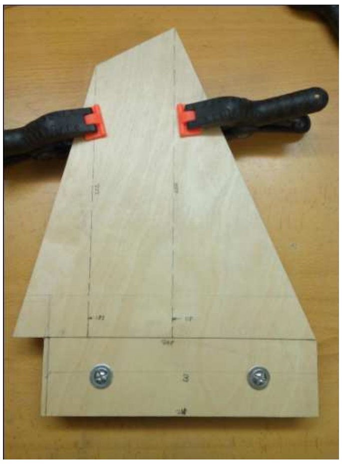
The centering rings of the motor mount tube will be joined together with two Ø6 mm rods sheathed in aluminum tubes with washers and nuts, and eyebolts at one end to form a rigid assembly that supports and transmits the thrust of the engine to the fuselage safely, which is detailed below.



3.5.- Fins, Centering Rings and Electronic Bay Caps

Both the main and longitudinal fins are made of Finnish birch plywood with a nominal thickness of 5 mm.

All of them are laminated on both sides with fiberglass fabric of 166 gr/m2 and pressed while hardening the epoxy, insulating them with vegetable paper as a release agent.




The centering rings are also laminated on both sides with the same material and pressed.

The electronic bay covers are laminated on the outer faces and are also pressed while the epoxy hardens.



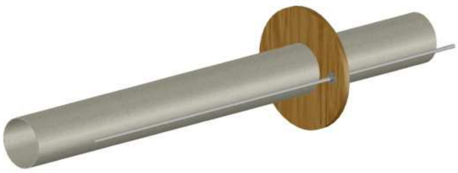
4.- Section 1 Drive

4.1.- Virtual Sequence of Assembly of Section 1 Drive

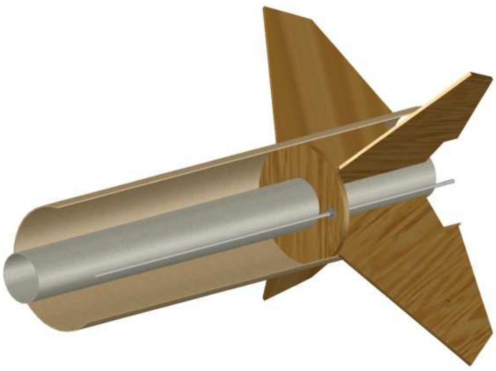
(For the gluing of all the components "***Z-POXY 30 minute formula***" is used)

1.- Firstly, the 3" motor tube with 2 PV layers of 166 gr/m2 will be reinforced as mentioned above. Then all the Rings will be machined with the necessary holes for the Rods of union between Rings and Thrust Washer.

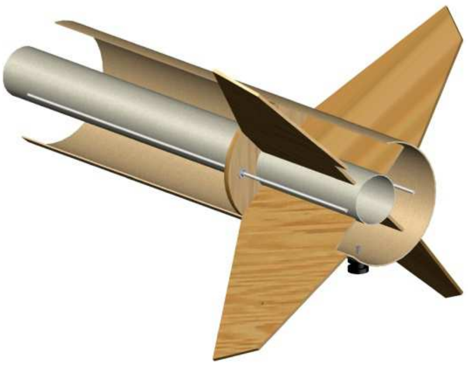
The Central Ring will then be glued to the motor mount tube in place with 30-minute epoxy.
Protect the inside of the tube from the back with body builder tape to avoid staining with the adhesive.



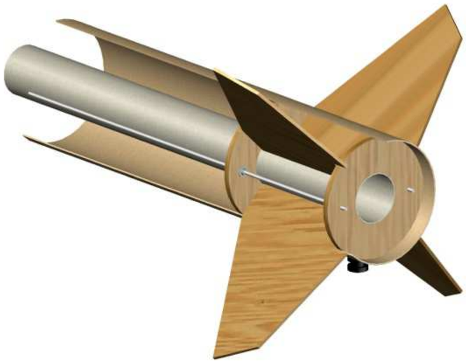
2.- Once the joint has hardened, push and reinforcement rods of 6 mm Ø will be placed on the Central Ring in the corresponding situation, fixing them with wide flat washers and nuts, applying some epoxy to them to ensure them.



4.- Proceed to glue the Main Fins through the slots (slots) previously made in the rear tube of the fuselage.
From the back, the epoxy binding cords will be reinforced with a stick or brush to extend it.



5.- It will proceed to fix the Rear Rail Button in an inner reinforcement of the tube or a square will be applied to the Rear Ring for its interior that serves to screw and fix said Button later.



6.- The rear Centering Ring will be glued, previously placing the nuts and inner washers. Later, the union of the Ring to the inner part of the fuselage will be reinforced, with an epoxy cord and a strip of FV.
Prior to this Ring, four nuts will be inserted for the retaining of the motor retainer.
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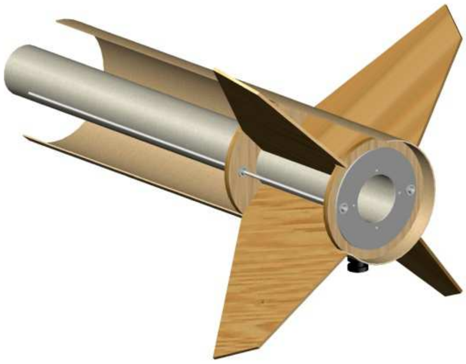
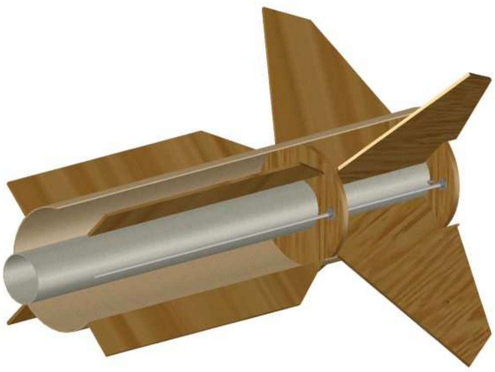
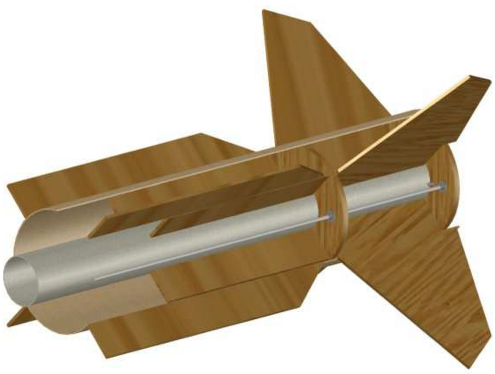


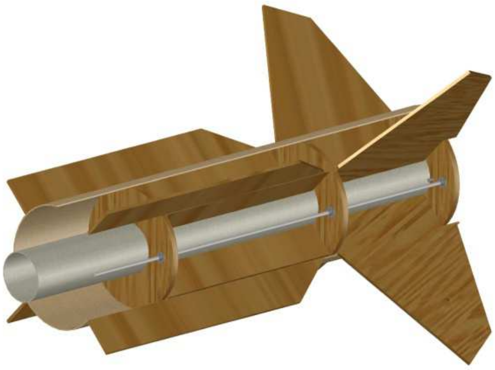
7.- The Thrust Ring, 2.5 mm thick dural and Ø 160 mm, will be glued to the rear Centering Ring and fixed with wide washers and nuts to the push rods.



8.- It will proceed to glue the back of the longitudinal fins by previously placing rivet-like lugs from inside the tube to a hole made in the fins that promote the alignment of the same with the main while sticking.

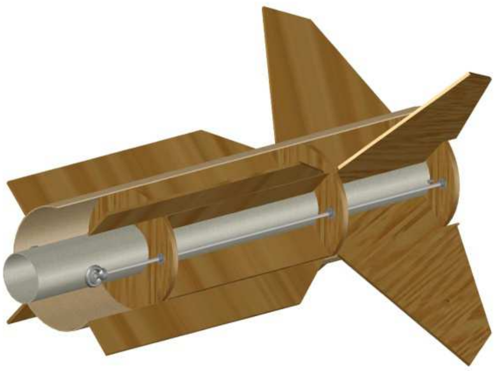


9.- The inner surface of the upper part of the rear tube of the fuselage will be previously protected with paper, through which the coupling of the central body must be slid back.
Then proceed to glue the ribs in extension with the roots of the fins.



10.- Then proceed to glue the front centering ring including the washers and nuts for fixing and transmission of stress.

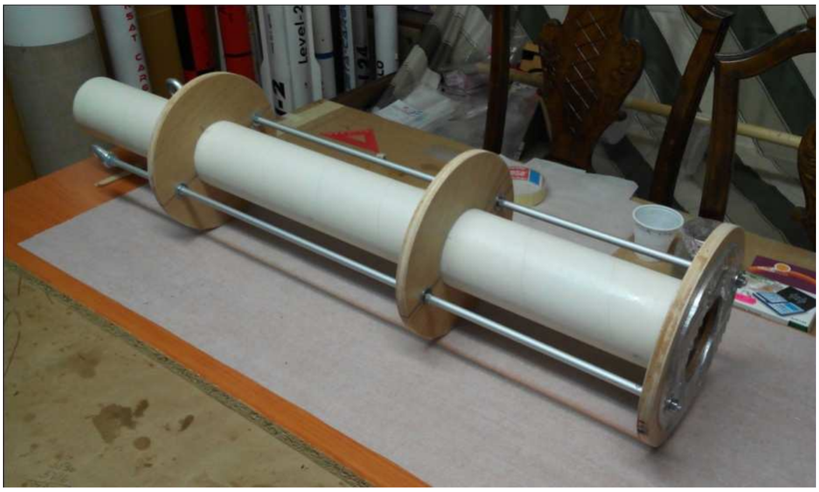
11.- The 2.5 mm thick rear motor retaining ring with its four screws that can be screwed onto the nuts previously inserted in the rear centering ring can be placed.



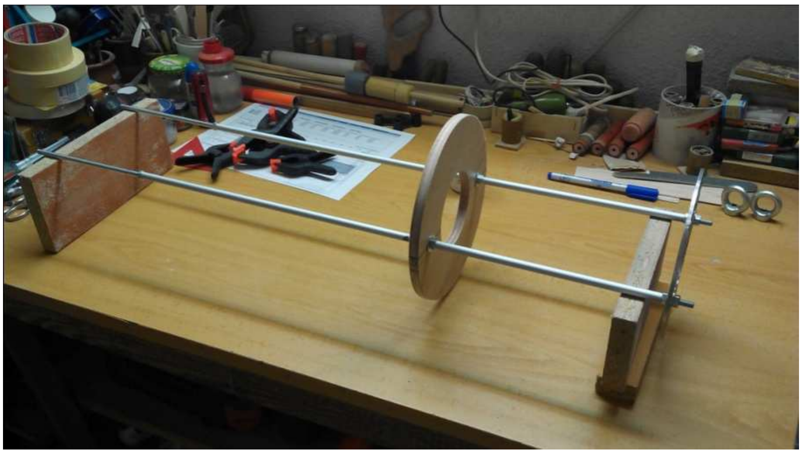
12.- And finally, the eyebolts will be screwed into the tip of the rods, securing them with nuts above and below and epoxy, to tie the sock cords with the rest of the parts of the fuselage during the descent in their recovery.

4.2.- **Section 1 Drive** (Physical construction)

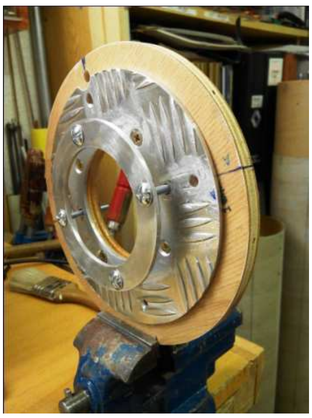
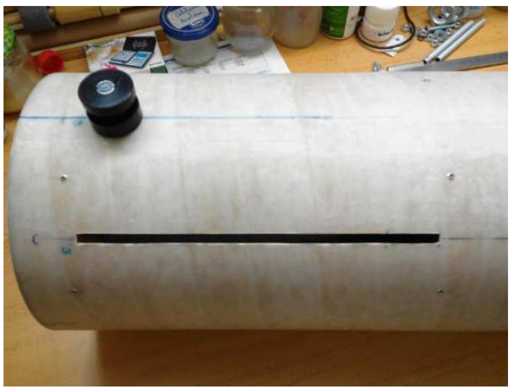
The motor mount assembly is presented with the rings, rods, aluminum spacer tubes, ending in respective eyebolts as anchoring points for the suspension cords, positioning and shaping the whole according to the corresponding measurements.
All centering rings will be fixed with nuts and washers.




Gluing process of the Central centering Ring:
Next, the Central Ring is attached to the motor mount tube with the corresponding rods and nuts, locating the rear ring and spacers to fix the position while the epoxy hardens.



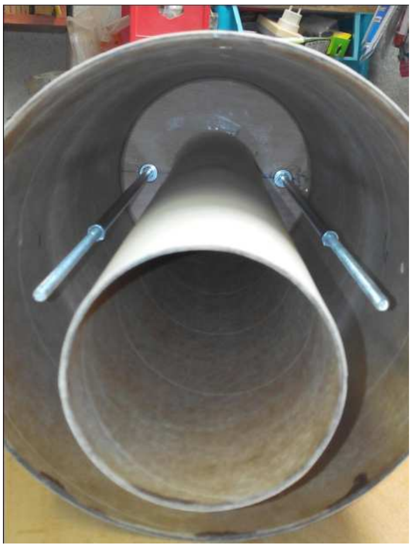
The rear ring is fitted with M5 tine mortise nuts that will later be used to fasten the motor retainer ring.

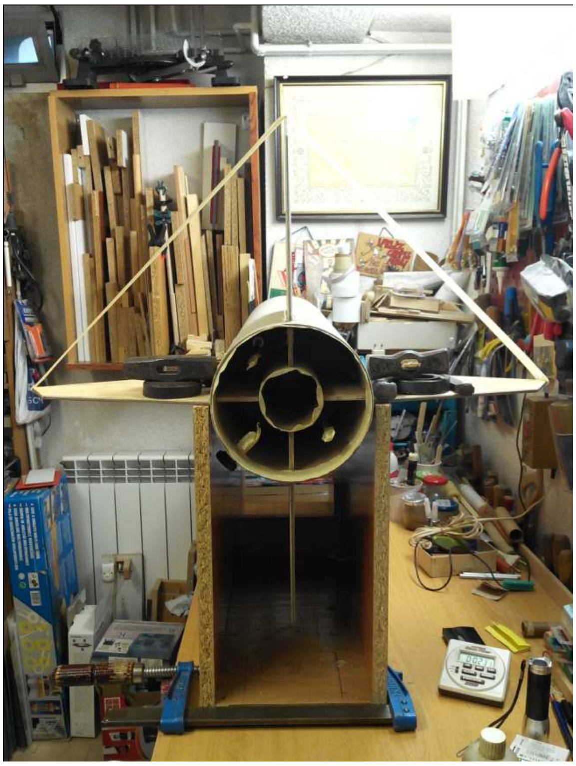
Next, the motor mount tube assembly with the Central Ring is glued inside the fuselage.
The rear Centering Ring will only be positioned to center the motor carrier but without sticking. Subsequently, it will be removed in order to reinforce the inner glue from the back.

4.3.- Gluing the Main Fins

Previously the slots have been made in Section 1 drive and proceed to glue two opposite Main Wings giving a *30' epoxy* bead both to the inner edge and to the two lateral lines that match the edges of the slot.



They are introduced by their slots and pressed against the motor mount tube. Previously they have prepared some supports of the height corresponding to the plane of assembly of the fins (previous calculation) and that will serve as support and will allow to place them in the same plane and center them with the axis of the fuselage fastened with some weights.



The interior surface of the fuselage end will be previously protected with painter's tape, where the rear centering ring will have to be slid to paste it, reinforcing even with a bead of epoxy putty the union of the ring to the lower inner edge of the fuselage.

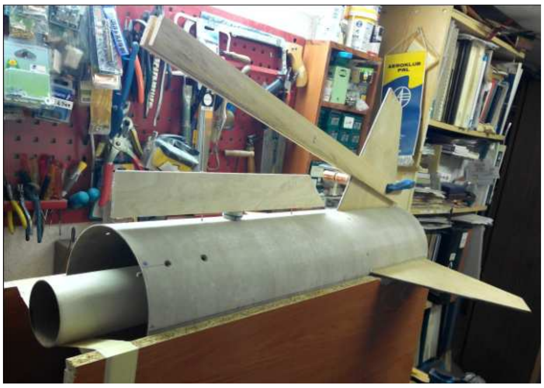
The other two fins perpendicular to these are stuck looking for that perpendicularity based on a system of measurement and tension from the fins previously stuck. As you can see in the photo. First one and then the opposite.

Both in the vertical fin of the previous step and in the opposite of this next step we paste the same areas and ensure their verticality by helping us with a tape and measuring both sides we ensure the equality of both measures.

4.4.- Gluing of Longitudinal Ains (lower part)

Then proceed to glue the first parts of the longitudinal fins, for which two strips are used to ensure alignment with the main fins.

The location of the longitudinal fins that have previously been trimmed and rounded their outer edges and waterproofed with celluloid solution with acetone is traced.



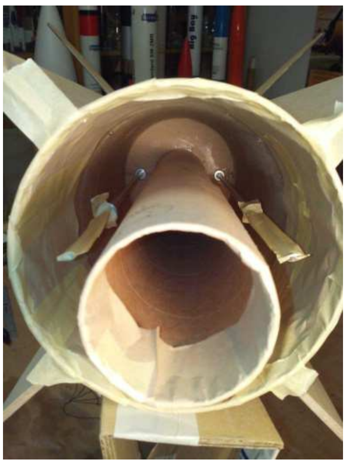
These longitudinal fins are reinforced with *screws Ø2.5x25 mm agglomerated threaded* acting as pins from the inside of the fuselage are inserted in two holes of the base of the fins as a joint assembly (all areas to be bonded with epoxy are sanded previously).

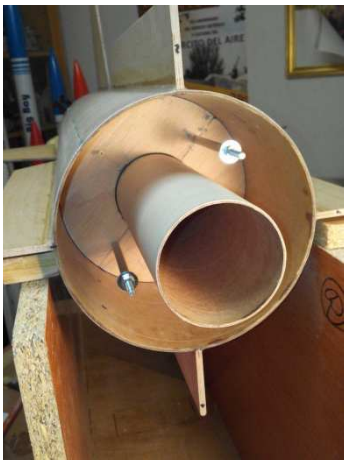
With the two slats attached to the main fins we ensure the alignment of the longitudinal fins. Subsequently a similar operation is performed with the upper sections of said longitudinal fins as can be seen in the following photo, proceeding with each one of them.

All the glueings of the external joints of the fins with the fuselage, after the initial bonding, will be reinforced with an epoxy cord with a radius of agreement of approximately 1 cm.

4.5.- Interior partitions and third centering ring

Next, we glue the partitions internally, on the upper part following the vertical part of the inner part of the fins, to reinforce the connection of the fuselage with the motor carrier. Then we paste the centering ring number 3. On the rods we place washers and nuts, we slide the aluminum spacer tubes as well as nuts and washers to stop the end lugs.





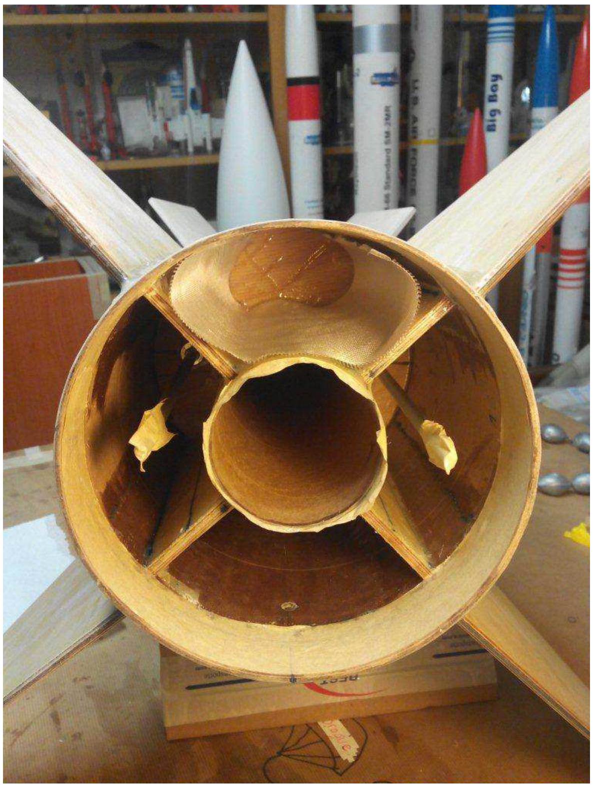
Once the bond has hardened, we reinforce the whole upper circumference of the fuselage with an epoxy putty bead.



4.6.- Reinforcement of the Roots of the Main Fins

Then proceed to reinforce the internal joints with the motor mount tube and the fuselage of Section 1 Drive. To do this, FV of 166 gr/m2 will be used, covering all the inner union dihedrals, reinforcing them with an epoxy cord of approximately 1.5 cm radius.
The **support bracket of the rear rail guide Button** shall also be glued, making sure of its exact position and subsequently glued and screwed to the Rear Closing Ring.

4.7.- Rear Ring and Push Ring



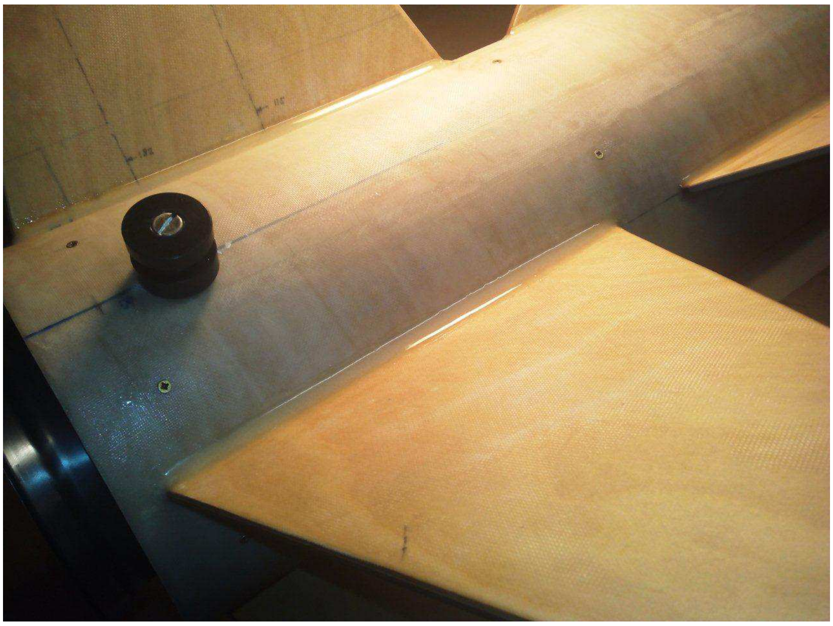

Finally the Rear Ring will be glued, which will incorporate the Thrust Ring.


4.8.- Retainer and False Nozzle

The Rear Ring will be reinforced with a cord of epoxy putty in its lower union with the fuselage. A false nozzle (to cushion the landing hit) and the Engine Retainer will be incorporated.

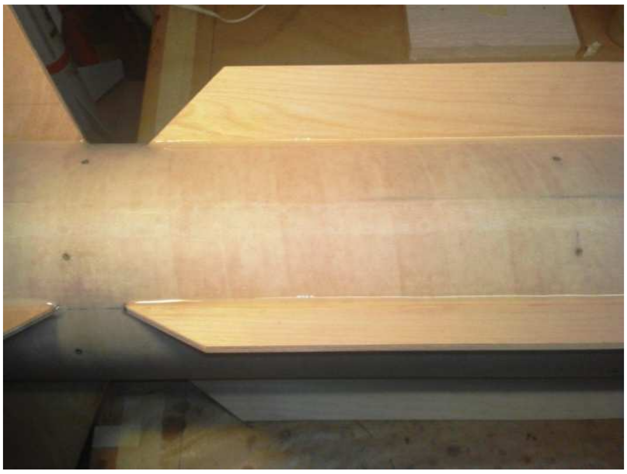
A *false motor* has been made to present the fastening of the same with the retainer ring that will be made with 4 screws M5x40 in the nuts that were previously embedded in the rear ring.

4.9.- Encounter of Fins with Fuselage - Radio of agreement



All external joints of both the main and longitudinal fins will be outlined with an epoxy bead (of 30') with a radius of agreement of 1.5 to 2 cm as reinforcement and aerodynamic profiling.

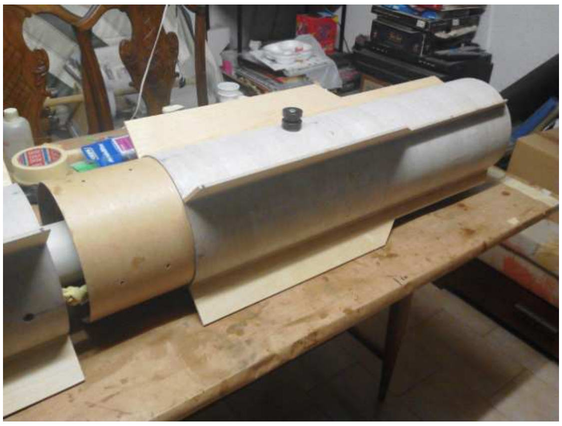
In addition, each of the centering rings (1, 2 and 3 of Section 1) will be reinforced with 8 screws of agglomerated thread of 2.5x25 mm in their periphery. To do this, a drill is made from the outside, filler and filled with epoxy by screwing the screws.



5.- Section 2

5.1.- Coupling with Section 1

This section of 700 mm will be coupled with Section 1 Drive by a coupler of 481 mm that previously will be laminated internally with two layers of FV fabric of 166 gr/m2 and then it will be glued inside the tube with epoxy leaving externally 140 mm for the coupling.



In this section we will also fix the upper guide button using a previously pressed flat M6 mortise nut, which will be glued from the inside to 2 cm before the end of the coupler taking advantage of the fact that the wall is double with a thickness of more than 5 mm.

The coupling area will be fixed with 8 screws M5x10 and nuts with washer glued inside the coupler reinforced with epoxy putty as in the electronic bay.

5.2.- Longitudinal fins (front part)

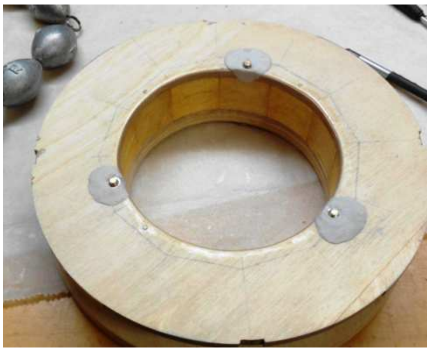
It proceeds to glue the front part of the longitudinal fins following a previous layout and aligning them with the corresponding lower parts with some rules.

5.3.- Lead ballast

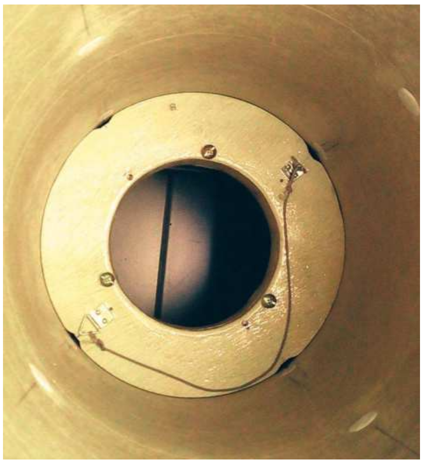
In addition, a ring with a housing that will serve to introduce a lead weight of approximately 1 kg will be glued inside.

This ring will be introduced from the top and will be glued against the upper edge of the coupler that connects Section 2 with Section 1 Drive, thus more effectively withstand the inertia at the time of starting the engine.

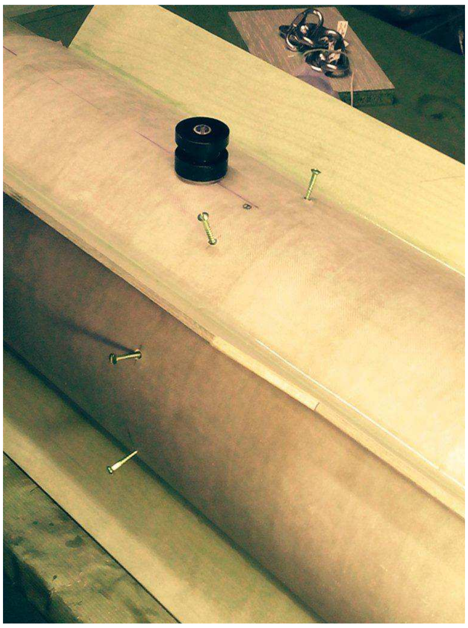




Up there is a 10 mm thick ring that will be fixed with 3 M4x60 screws with the lower ring that has been incorporated with M4 barbed nuts.

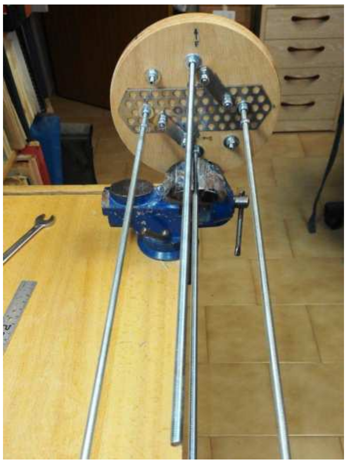
In addition from the outer periphery will be introduced 8 screws screw agglomerate of 3.5x30 as reinforcement but without gluing to be able to remove the ballast in possible future launches with "L" engines.



6.- Section 3 and Electronic Bay

6.1.- Electronic Bay

The electronic bay will be made with a coupler reinforced with 2 layers FV of 166 gr/m2 by the inner surface of the tube. In this model it is necessary to incorporate double redundant electronic system both for the ejection of the DROGUE and the MAIN.



A portion of the fuselage of Section 3 of 60 mm that we will call Section 2 will be cut to stick it to the center of the body of the Bay that will act as a push between sections 1 and 3.

To proceed to assemble the electronic bay, begin by gluing two sets of caps, one of the outer diameter and one of the interior, which will be the top (up) and bottom (down) of said bay.

The 10 mm thick plywood tops that were laminated on one side will be used and will be joined by the non-laminated and centered faces so that the smallest one enters the cylinder of the Bay and the second one comes up against the edge of the same.

The lids will be reinforced both the outer and the inner side with each sheet of 1 mm steel plates, glued with epoxy, in the areas where the rods are placed and the "U-bolts".

The caps will be machined by making the holes for the "U-bolts" of hooking, the connecting rods of both, the ejection charge cups, cable glands, clamps and for the connection cables of the igniters of said loads.

Stainless steel mesh filters will be used as a "spark arrester" screen for ejection loads.



They will be assembled with 4 rods of diameter Ø6 mm with normal nut and self-locking lock nut on the fixed side and nut and wing nuts on the removable.

Two "U-bolts" of Ø8 mm stainless steel and M6 thread with nut and self-locking lock nut will be used.

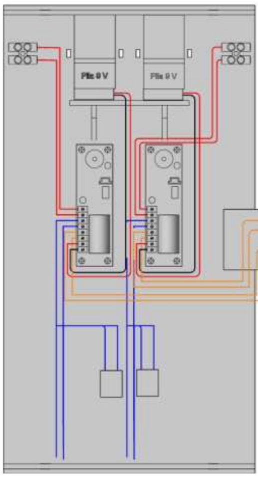
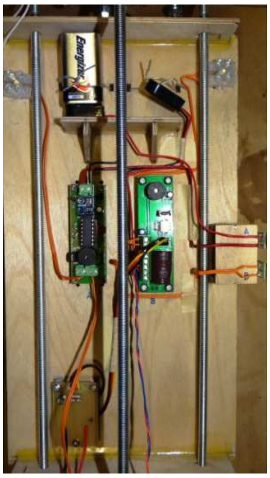
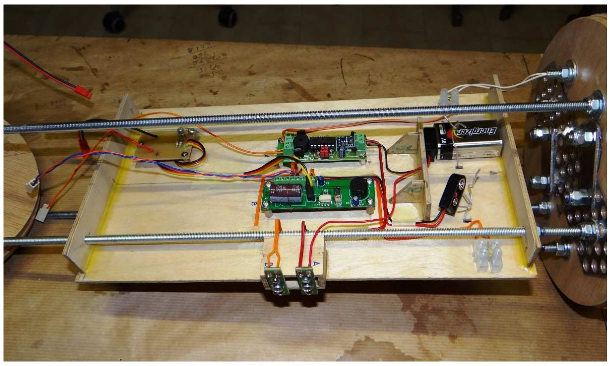

Once the entire assembly is machined, the drill holes for the bay to the upper fuselage, Section 3, of the rocket body will be placed.

Once done, proceed to countersink the external hole in the fuselage so that the head is flush with the surface of the fuselage.
The screws selected in this case will be M5x10 with conical head.
Internally, built-in washer nuts will be placed, which will be secured with epoxy putty to give as much resistance as possible.

4 staggered sets of 3 screws will be placed each in four groups around the upper part of the Bay. In total 12 screws.

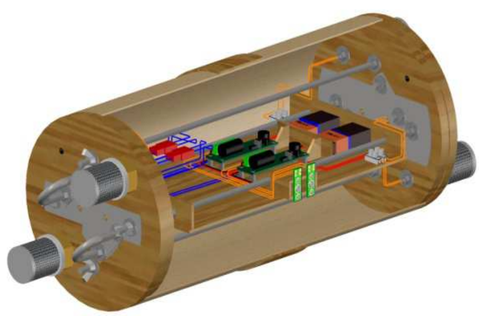
6.2.- Support and internal electronics

In this case 2 altimeters, already experienced previously, will be incorporated, with power and ignition by means of two screw switches, which will act on independent loads that will result in the same ejection zone of both the DROGUE parachute and the MAIN.

The plywood support is assembled for electronics, batteries and screw switches. The assembly will be supported by two of the threaded rods of Ø6 mm that join the lower cover with the upper one together with the coupling tube that make up the electronic bay (this will serve to join the upper fuselage with the lower one). Two aerial connectors are envisaged in the connection cables of the rear igniters (for Drogue ejection) that enable the dismantling of the Bay.

The longitudinal position is subsequently adjusted so that the switches are accessible from the outside by the pressure balancing holes, by means of two stop nuts in front and behind the support.
Centered on the outside of the body of the electronic bay, the small Section 3 of the external fuselage tube is glued with epoxy, which serves as a stop for the lower fuselage and in turn pushes the upper one.



In relation to the size of the bay, two holes of Ø11 mm will be made, which are the necessary ones according to the attached calculation, to balance the interior and exterior barometric pressure for the sensors to detect it.

These holes will also act on the two screw switches to turn on and off the two altimeters. On the instructions of **Paolo Basso**, two more holes of Ø10 mm will be made in the periphery at 120º on each side of the switches to ensure the balance with the external pressure.

These electronic devices will give the order of ejection of the **DROGUE** in Apogee for a fast descent and whose size will be calculated later so that the speed of descent is included between **15 and 20 m/s**.

Subsequently, they will give the order to eject the **MAIN** parachute at the height that is programmed (advisable 250 m the Altimeter SRAlt and 200 m the second) to ensure the opening of the MAINs, and that will be calculated equally, for a descent speed between 4.5 and 5.5 m/s

6.3.- INSTALLATION and CALCULATION for Altimeters

Considerations for the **Installation** of the SRAlt and AltiDuo altimeters, and **Calculation** of the holes for balancing the internal pressure of the bay with the exterior (Manuel Morales system and formulas).

INSTALLATION and calculation of "vent holes" of the electronic bay

To install the altimeters, the following points must be taken into consideration:

1.- Altimeters must be installed in an area of the rocket isolated from other equipment. We will call this area electronic bay (e-Bahia).

2.- The e-Bahia must be an airtight zone except the Orifice (s) made to balance the internal pressure with the external pressure (vent holes).

3.- The e-Bahia must be located between the base of the Nose Cone and the start of the stabilizing fins. As a general rule, half of the distance separating the two zones can be estimated as acceptable, or at least placed at a distance equal to 4 times the diameter of the rocket from the base of the Ogive. The area where the bay-altimeter is located must be free of obstacles, eg ramp guides, changes in diameter of the rocket body, etc). In this case it will be located in Section 3 that is in the center of the rocket.

For the balance between the external pressure and the internal pressure of the e-Bay, one or more holes (vent hole) will be made in the wall, whose approximate diameter is given by the equation.

If several holes are made, they will be equidistant from each other and in a plane perpendicular to the longitudinal axis of the rocket.

d_{ba} = 18,8 cm

l_{ba} = 36,2 cm

n_{vh} = 2 holes

$$d_{vh} = \sqrt{\frac{d_{ba}^2 \times I_{ba} \times 0.484}{2500 \times n_{vh}}} = 11 \text{ mm}$$

Relationship between the diameter of each vent hole and the size of the altimeter bay

where:

d_{vh} = diameter of each vent hole in mm

I_{ba} = Inside diameter of the loading bay in cm

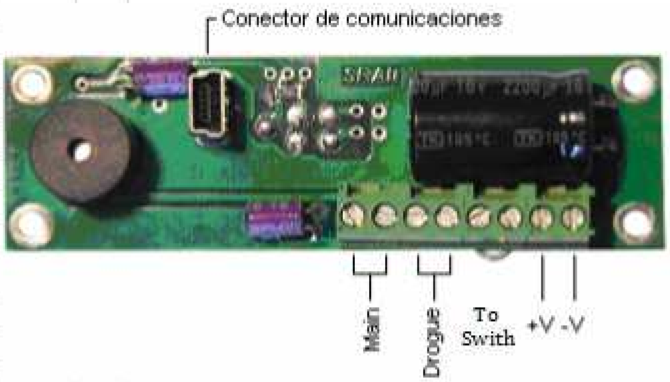
l_{ba} = Inside length of loading bay in cm

n_{vh} = number of vent holes used

They will be done 2 holes 11 mm of diameter in the central zone coinciding with the position of the two switches and thus to be able to act these from outside.

Batteries Altimeters: To feed these altimeters you can use a 9V alkaline battery for each, or a LiPo battery of three elements of about 620 mAh capacity for each.

The connection of the elements that make up the used SRAlt altimeter is shown in the figure



Connection

6.4 Balanced Holes Pressure of Drug Loading Bays and Main

Calculation of "vent holes" for pressure balancing in Load Bays

In Section 4 for the MAIN

To balance between the external and internal pressure of a loading bay (for Main and / or Drogue), make a hole (vent hole) in the wall of the bay, whose approximate diameter is given by the equation.

It is also possible to make several holes equidistant from each other and in a plane perpendicular to the longitudinal axis of the rocket.

d_{ba} = 19,1 cm
l_{ba} = 46,3 cm
n_{vh} = 3 holes

$$d_{vh} = \sqrt{\frac{d_{ba}^2 \times I_{ba} \times 0.484}{2500 \times n_{vh}}} = 10 \text{ mm}$$

Relationship between the diameter of each vent hole and the size of the cargo bay where:

d_{vh} = diameter of each vent hole in mm
l_{ba} = Inside diameter of the loading bay in cm
l_{ba} = Inside length of loading bay in cm
n_{vh} = number of vent holes used

Will be made 3 Holes of 10 mm in diameter at the top of Section 4, 2 cm below the Ogive coupling, in opposite positions.

Calculation of "vent holes" for pressure balancing in Load Bays

In Section 2 for the DROGUE

To balance between the external and internal pressure of a loading bay (for Main and / or Drogue), make a hole (vent hole) in the wall of the bay, whose approximate diameter is given by the equation.

It is also possible to make several holes equidistant from each other and in a plane perpendicular to the longitudinal axis of the rocket.

d_{ba} = 19,1 cm
l_{ba} = 62,3 cm
n_{vh} = 4 holes

$$d_{vh} = \sqrt{\frac{d_{ba}^2 \times I_{ba} \times 0.484}{2500 \times n_{vh}}} = 10 \text{ mm}$$

Relationship between the diameter of each vent hole and the size of the cargo bay where:

d_{vh} = diameter of each vent hole in mm
l_{ba} = Inside diameter of the loading bay in cm
l_{ba} = Inside length of loading bay in cm
n_{vh} = number of vent holes used

Will be made 4 Holes of 10 mm in diameter at the top of Section 2, 2 cm below the coupling of the e-Bay, in opposite positions

6.5.- Ejection Charges

2 ejection charges will be needed:

1. One to separate the bottom of the rocket (set Sections 1 and 2) from the top of it (e_Bay, Section 3-4 and Nose Cone) for ejection of the Drug.
2. Another to eject the Nose Cone and eject the Main parachutes to a lower height programmed for the final descent.

For the calculation of the charges, the diameter and the strength desired in each case will be taken into account according to the attached table (José Luis Sanchez formulas),

Presión aconsejada según diámetro del fuselaje y Fuerza deseada				
Lbs	100	150	200	250
Kg	45	68	91	114
Ø Cámara				
2.6"	19 psi	28 psi	38 psi	47 psi
4.0"	8 psi	12 psi	16 psi	20 psi
6.0"	3.5 psi	5.3 psi	7.0 psi	8.8 psi
7.5"	2.3 psi	3.4 psi	4.5 psi	5.7 psi

In the case of the DROGUE for the diameter of 7.5 "we consider 7 PSI (0.5 Bars) to ensure its opening.
In the case of the MAIN with a larger Vano and having to shear the 3 nylon screws of Ø3 mm (shear pins) it is considered convenient an overpressure between 9.6 PSI (0.66 Bars) and 12 PSI (0.83 bars) based on experiences in models Ø 3 "and 4".

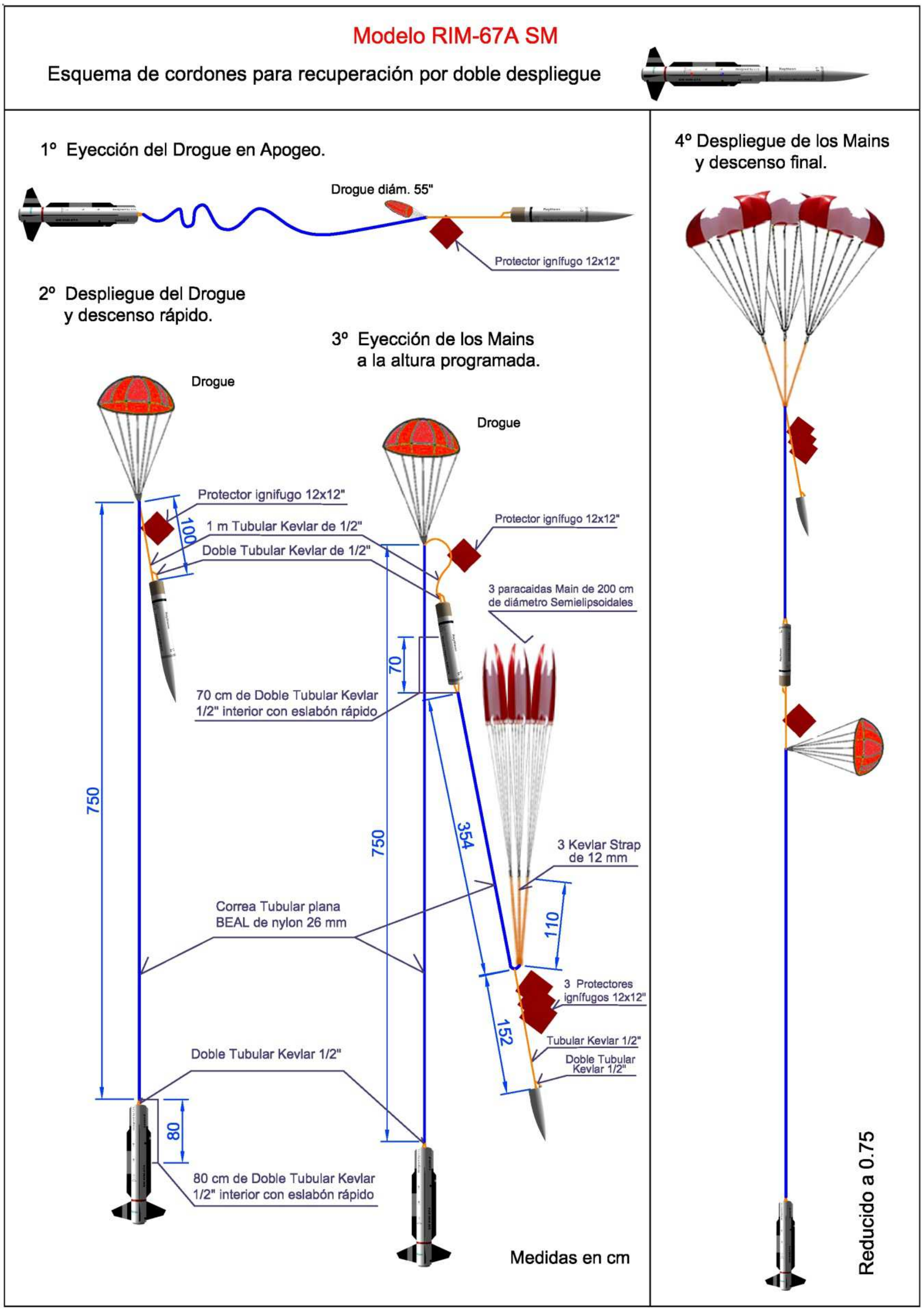
Cálculo para el SM RIM-67A para Certificación L3									
Camera / Cámara					Pressure & BP / Presión y BP				
Camera / Cámara	Ø		Length/Longitud		Pressure/Presión		BP/Pólvora	Fuerza/Force	
	inch	mm	inch	mm	PSI	Bares	Weight/Peso gr	KG	Lbs
DROGUE	7,51	190,8	24,7	627	7,3	0,50	**4,0**	**143**	315
MAIN - a	7,51	190,8	18,5	470	12,0	0,83	**5,0**	**237**	523
MAIN - b	7,51	190,8	18,5	470	9,6	0,66	**4,0**	189	416

However, I have already performed a static test to verify the result using 4 gr to eject the Drogue and 5 to eject the Main,s which has been satisfactory, and in section 10 (page 35) it is detailed..

7.- Recovery system

7.1.- Connection diagram of the cords between the different elements

Below is a diagram of the deployment of the string that will be used in the recovery of the model by double deployment of parachutes from its Apogee.



7.2.- Calculation of the Drogue

Based on the system indicated in the previous diagram below, the dimensions of the parachutes and the corresponding efforts that each element will have to support are calculated.

DROGUE - Braking parachutes (Project L3)

To calculate the drogue, the terminal velocity equation can then be rearranged to calculate the desired size of a circular parachute. The simplified equation is shown below, and a desired descent rate between 15 and 20 m / s (50 to 65 ft / second) is assumed.

$Mc \cdot g = k \cdot V^2$ where: $k = \rho \cdot A \cdot Cd / 2$ being A the area of the Drogue, $A = \pi \cdot D^2 / 4$

clearing **D**:

$$D = \sqrt{\frac{8 \times Mc \times g}{\rho \times \pi \times Cd \times V^2}}$$

where:

D = Diameter in meters of the Drogue

g = Acceleration of gravity	g =	9,81	m/s^2
ρ_0 = air density in N. C.	ρ_0 =	1,29	Kg/m^3
t = Temperature of the place in ºC	t =	**15**	ºC
Zt = Altitude of the land in meters above sea level	Zt =	**186**	m
Mr = Mass of the rocket on ramp	Mr =	**20,529**	Kg
Cd = Aerodynamic drag coefficient	Cd =	**0,75**	
V = Desired rate of descent	V =	**17,0**	m/s
Mp = Propellant mass	Mp =	**2,722**	Kg
Hap = Predictable height of apogee on the ground	Hap =	**1000**	m

Mc = Rocket mass in fall

Mc = Ramp mass - Propellant mass:	Mc = Mr -Mp =	17,807	Kg		
Zap =Altitude of apogee in = Zt + Hap m a.s.l.	Zap =	1186	m		
ρ = Density of the air at T ºC and Zap m a.s.l.	ρ =	1,06	Kg/m^3		
Resulting:	**D =**	**1,39**	m <>	**54,7 "**	
A = Drogue area	**A =**	1,52	m^2		

Shock Force at the Opening of the Drogue: (Based on the maximum speed in Free Fall)

For a rocket with a Nose Cone of **diameter d and a mass on fall Mc**, where:

dc =Rocket body diameter	**dc** =	**19,6**	cm		
Cx = Form coefficient: Circular = 1.7; Conical = 1.8; Cruciform = 1.1 to 1.2	**Cx** =	**1,7**			
Ac = Surface of the section of the rocket body = p · dc^2 / 4	**Ac** =	0,03017	m2		
Vt = Speed in vertical free fall = Root ((2 * Mc · g) / (Cd · ρ · Ac))	**Vt** =	120	m/s		
Vmax = For calculation, at an angle of 30º on vertical:	**Vmax** = Vt ·sine (30º) =	**60**	m/s <>	**217**	Kmh

Shock Force of the Drogue

Fs = Cd · A · (ρ / 2) · Vmax^2 · Cx	**Fs =**	**3728**	**N <>**	**380**	**Kg**

Density of air as a function of T and z (altitude)

$$\rho = \left(\frac{P_0}{RT}\right) exp^{\left(\frac{-g \cdot z}{RT}\right)}$$

where:

Po = Atmospheric pressure	101235	Pa
R = constant air =	286,9	J/kg·ºK
T = temperature in ºK = 273,15 + T ºC		
Zap = altitude in meters a.s.l.		
t ºC =	15	ºC
z = Zap =	1186	m
T =	288,15	ºK
ρ =	**1,06**	**Kg/m^3**

A Drogue of Ø55 "commercial would ensure the necessary characteristics and an approximate speed.

7.3.- Calculation of the MAIN Parachute

It is intended to use three Ø2m semiielipsoidal commercial parachutes equivalent to one of Ø3.46m <> Ø136 "which is commercialized by the Klima company that, as I have been able to verify in launch, with an L2 have an aerodynamic drag coefficient of 1.0.

MAIN - Main landing parachute (Project L3)

For the calculation of the Main, we use the same terminal velocity equation as for the Drogue but considering the maximum velocity the descent with the Drogue.

$Mc \cdot g = k \cdot V^2$ where: $k = \rho \cdot A \cdot Cd / 2$ being A the area of the Drogue, $A = \pi \cdot D^2 / 4$

clearing D: $$D = \sqrt{\frac{8 \times Mc \times g}{\rho \times \pi \times Cd \times V^2}}$$ where:

D = Diameter in meters of the Main			
g = Acceleration of gravity	g =	9,81	m/s²
ρ_0 = air density in N. C.	ρ_0 =	1,29	Kg/m³
t = Temperature of the place in ºC	t =	**15**	ºC
Zt = Altitude of the land in meters above sea level	Zt =	186	m
Mr = Mass of the rocket on ramp	Mr =	20,529	Kg
Cdm = MAIN aerodynamic drag coefficient	Cdm =	**1,0**	
Vm = Desired descent speed with the Main	Vm =	**5,5**	m/s
Mp = Propellant mass	Mp =	2,722	Kg
Hap = Height programmed ejection Main on the ground	Hap =	**200**	m
Mc = Rocket mass in fall			
Mc = Ramp mass - Propellant mass:	Mc = Mr -Mp =	17,807	Kg
Zap = Average altitude for calculation Main = Zt + 20 (m a.s.l.)	Zap =	206	m
ρ = Density of the air at T ºC and Zap m a.s.l.	ρ =	1,29	Kg/m³
Resulting:	**D =**	**3,37**	m <> **132,9 "**
A = Main area	**A =**	8,94	m²

Shock Force at the MAIN Opening:

Cx = Form coefficient: Circular = 1.7; Conical = 1.8; Cruciform = 1.1 t	Cx =	**1,7**			
Vmax = The one corresponding to the fall with the Drogue	Vmax = V =	17,0	m/s <>	61	Kmh

MAIN Shock Force

Fs = Cdm · A · (ρ / 2) · Vmax² · Cx — **Fs = 2837 N <> 289 Kg**

Density of air as a function of T and z (altitude)

$$\rho = \left(\frac{P_0}{RT}\right) exp^{\left(\frac{-g \cdot z}{RT}\right)}$$

where:

Po = Atmospheric pressure	101235	Pa
R = constant air =	286,9	J/kg·ºK
T = temperature in ºK = 273,15 + T ºC		
Zap = altitude in meters o.s.l.		
t ºC =	0	ºC
z = Zap =	3	m
T =	273,15	ºK
ρ =	**1,29**	**Kg/m³**

According to the simulation carried out with OpenRocket with the three semi-ellipsoidal parachutes of Ø200 cm, the descent speed is 5.45 m/s, which is acceptable for the Aerocinca field.

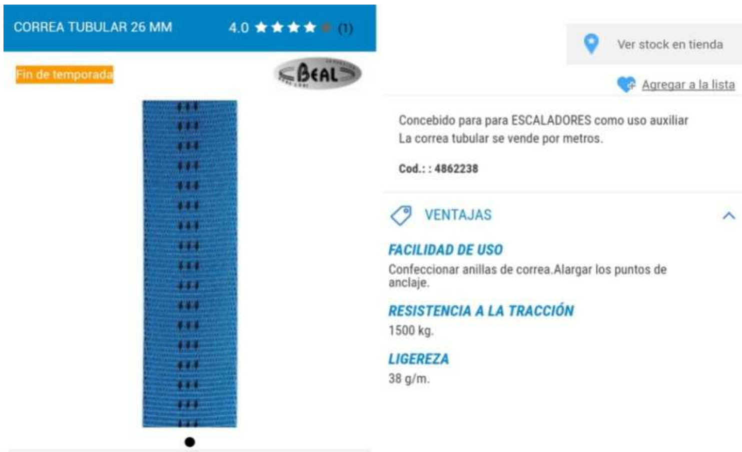
7.4.- Shock Cords and connections

According to the calculations the greater effort would be of 380 KG (834 Lbs) by which cordons superior to this number are selected so much those of Kevlar ignifugos for the zones of the loads of ejection as those of nylon.

At the joints with the two "U-bolts" on each side of the electronic Bay, 85 cm will be placed on each side of ½" (12.7 mm) Kevlar tubular cord with a unit strength of 900 kg. and fireproof to withstand the ejection charges of the Drogue and the Main.

A section of Kevlar (Kevlar Strap) tape of 12 mm and 500 Kg of resistance will be used in each of the Main parachutes to adequately separate the "V".

The rest of the connections will be made with flat 26 mm nylon tubular tape and 1500 Kg of resistance as follows:



To the Nose Cone 1 m of the tubular Kevlar of ½"(resistance 900 KG) will be attached to a quick link of 7 mm 25 KN where it will join one end of the nylon strap of 26 mm, 3.55 meters of length and resistance 1500 KG (15 KN).

In the three Ø2 m parachutes, the cords of each of these will be joined respectively to a 1.1 meter section of 12 mm Kevlar Strap and 500 KG resistance (5 KN).

And the three sections will be joined together to the previous threaded quick link.

The lower loop of the previous nylon strap will be attached to the upper loop of the Electronic Bay.

The loop of the lower cord of the Bay, of tubular Kevlar of ½", will be joined with a 26 mm nylon strip of 7.5 m in length to the 1 m Kevlar cord that will be joined to the two rods of the rods of Section 1 Drive. These will be joined with 8 mm quick link.

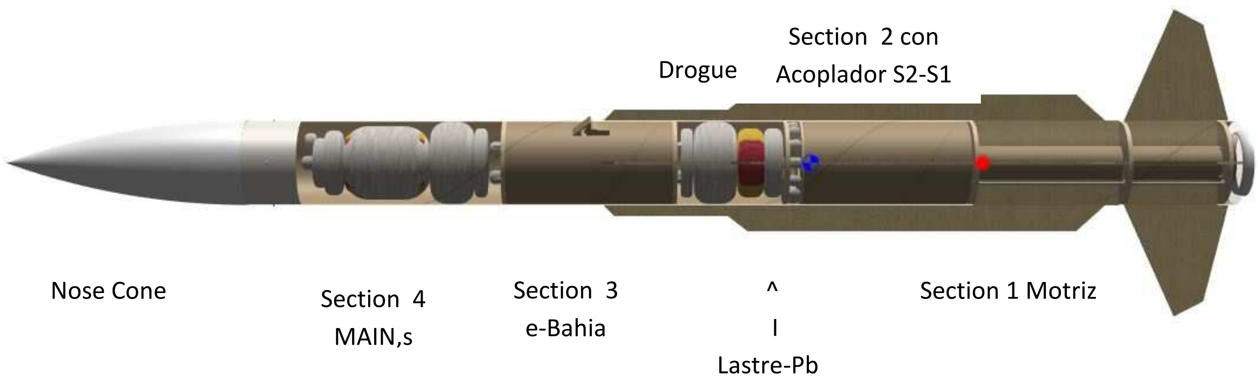
In the top link will join the Drogue.

In the diagram at the beginning of this chapter you can see the assembly clearly.

7.5.- Internal distribution of components

In the following image you can see the layout of all the components:

- **Nose Cone** to be fixed to Section 4 with three screws of Ø3 mm nylon as "*Shear Pins*" to prevent premature opening of the same in the heyday due to the deployment of the Drogue.
- **Section 4** with the Main's, its string and where the upper part of the Bay will be screwed.
- **Section 3** intermediate body as support of the electronic Bay.
- **Section 2** where the lower part of the bay will slide. It will house the Drogue, its string the ballast tank, the coupler between Section 2 and 1 and the upper part of the longitudinal fins.
- **Section 1 drive** where the coupler will be screwed. This incorporates the motor carrier with its three centering rings, the false nozzle, as well as the lower part of the longitudinal fins and the main fins.



8.- Section 4 and Nose Cone

In the Nose Cone a metal rocker arm bolt that offers more resistance than the factory mooring will be adapted. In any case the tubular cord will be attached to both ties.

Once fitted in the upper part of Section 4 (loading bay of the Main parachute), three holes will be made, equidistant perimetrally and at half height of the coupling of Ø3 mm and will be tapped to screw the safety nylon *Shear Pins*.

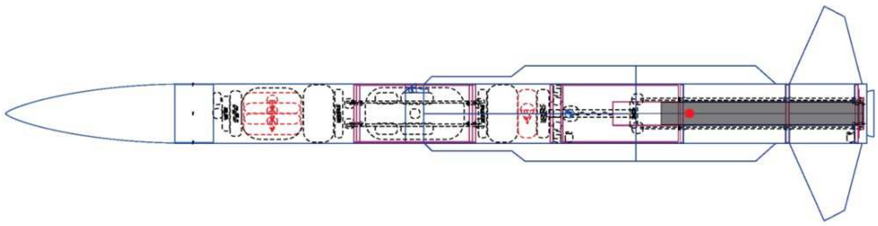
No element is introduced inside, so as not to increase its weight, which will avoid the possibility of its premature ejection, by inertia, at the moment of ejection of the drug.

9.- Flight Simulation - Data and Graphics

OpenRocket Simulator: with Aerotech M1297W-P engine of 5439 Ns.

The Thrust-To-Weight Ratio is: 1297 / (20.5x9.8) = 6.45 Gs.

Rocket Design



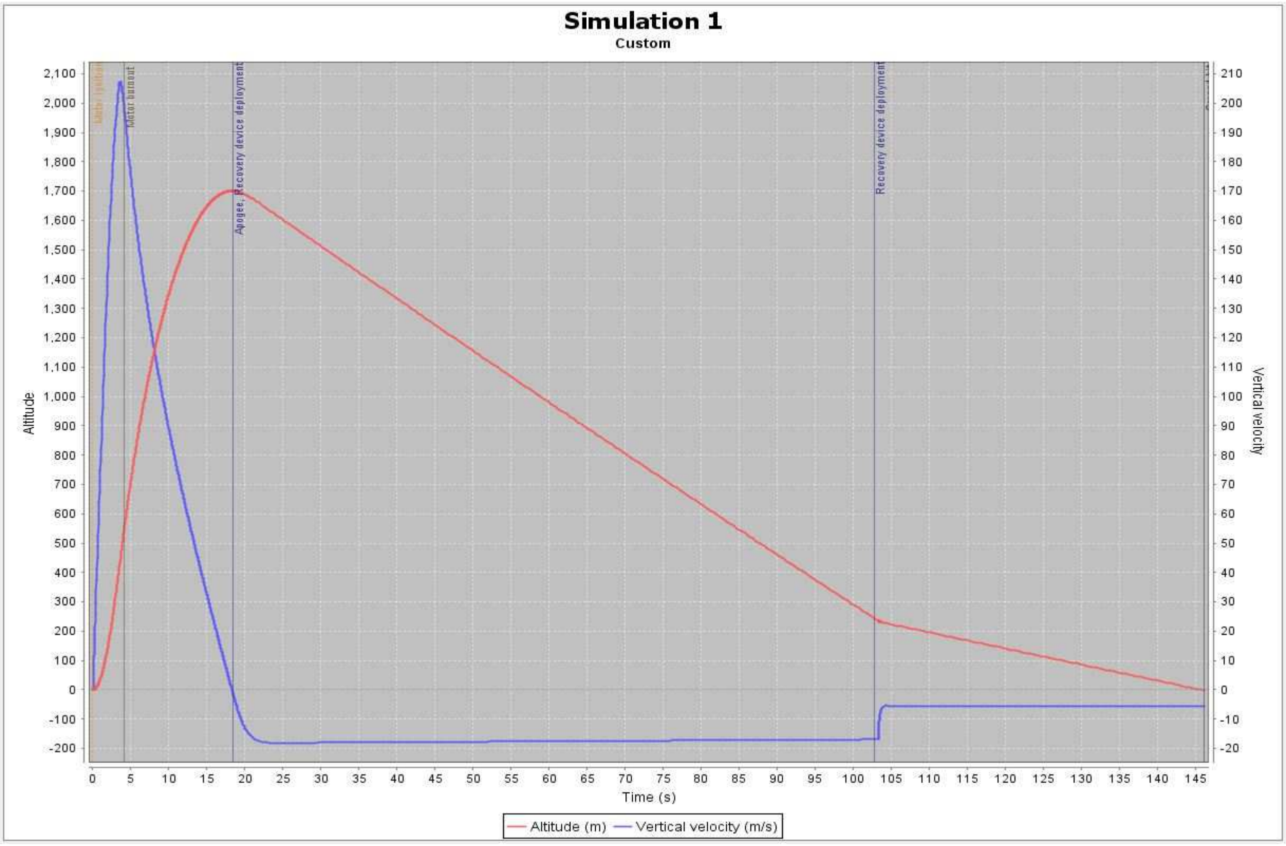
RIM-67A - Proyecto L3 - 2º E - Contrachapado finlandés con FV
Stages: 1
Mass (with motor): 20529 g
Stability: 2,02 cal
CG: 1862 mm
CP: 2258 mm

M1297W-P

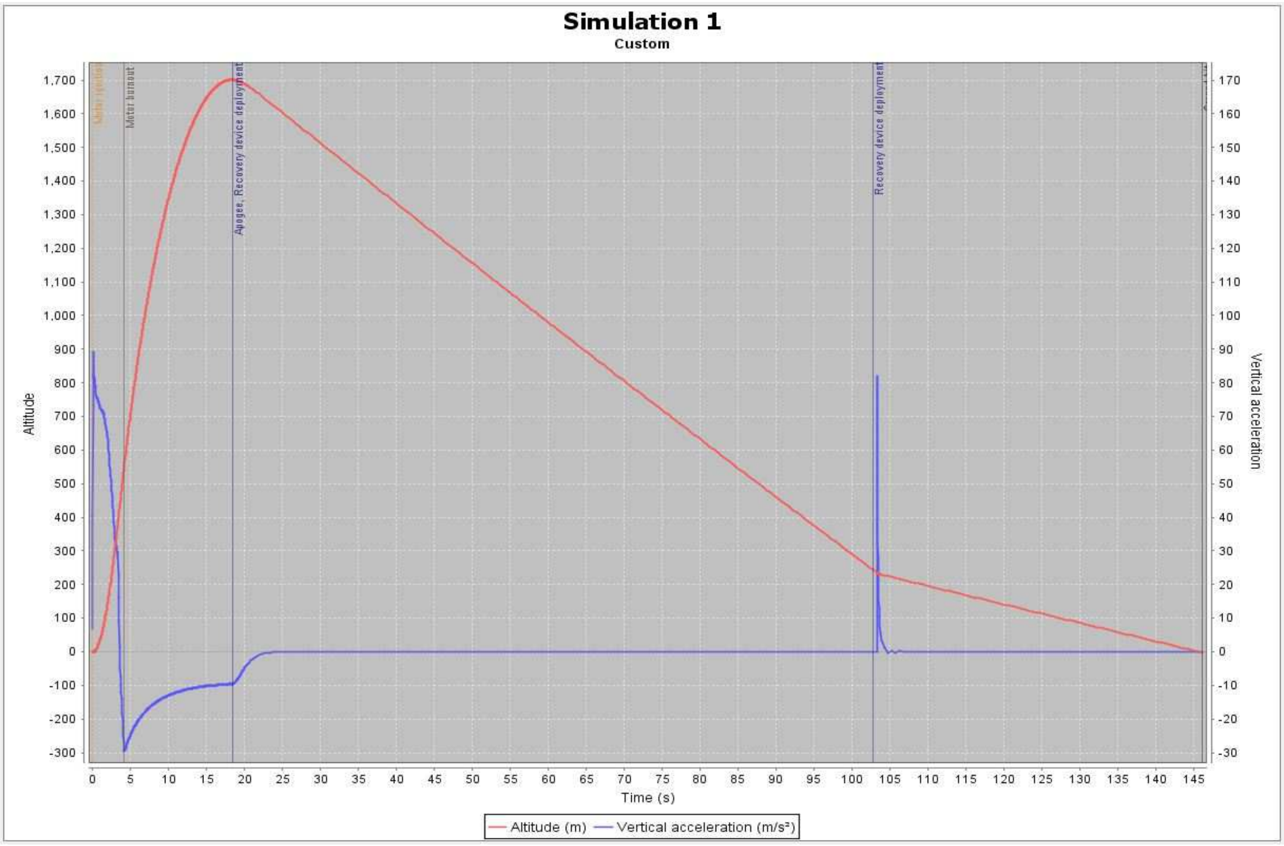
Altitude	1701 m
Flight Time	146 s
Time to Apogee	18,3 s
Optimum Delay	14,2 s
Velocity off Pad	20,1 m/s
Max Velocity	207 m/s
Velocity at Deployment	16,9 m/s
Landing Velocity	5,47 m/s

Motor	Avg Thrust	Burn Time	Max Thrust	Total Impulse	Thrust to Wt	Propellant Wt	Size
M1297 W	1339 N	4,06 s	2048 N	5439 Ns	6,65:1	2722 g	75/665 mm

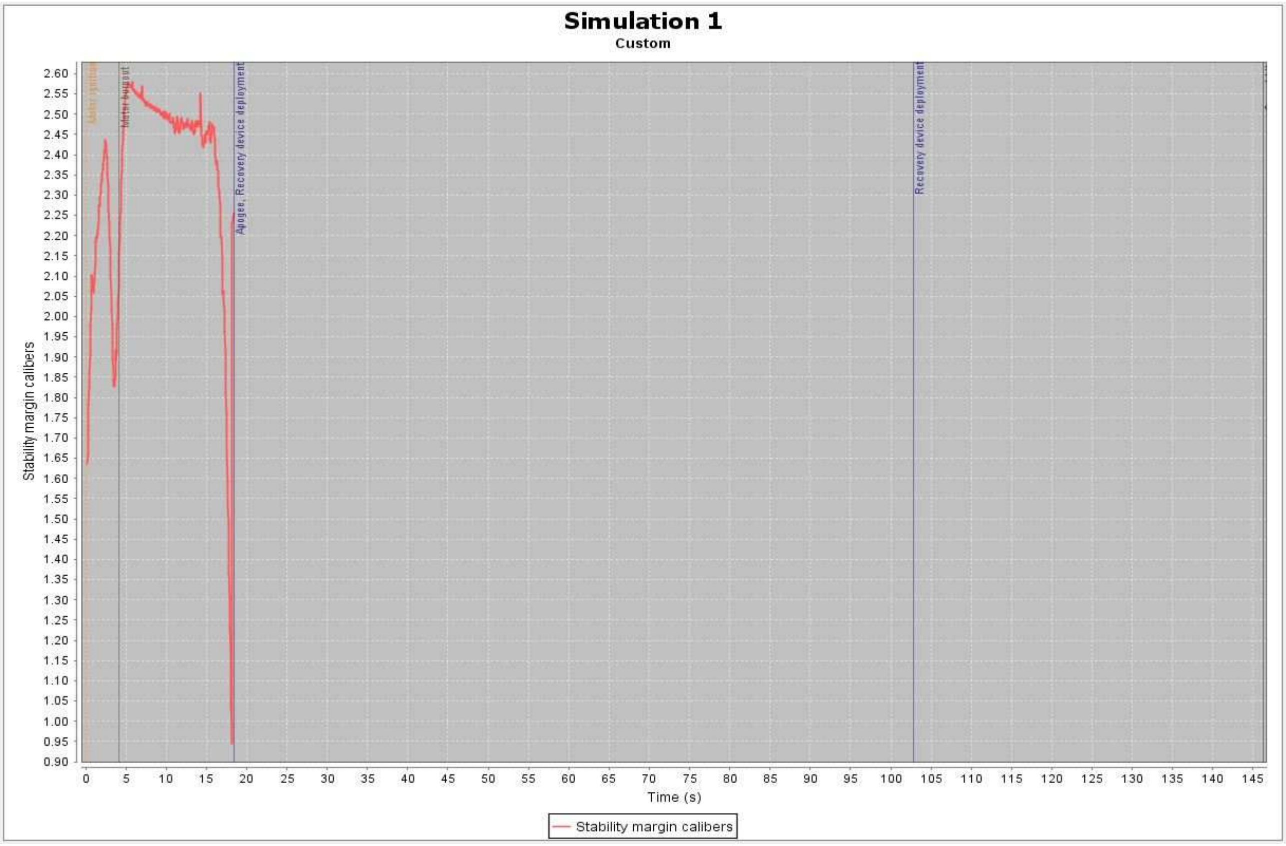
Graph of Altitude and Vertical velocity versus time. Max. speed 208 m/s <> 749 km/h - Mach 0.62.



Graph of Altitude and Acceleration versus time. Maximum acceleration 87 m/s² <> 313 m/s²



Stability graph in calibers versus time



The graphs of the actual flight according to the Altimeter SRAlt will be added later.

10.- Static test

Static test of the SM RIM-67A model. June 2018

Attached test of ejection of the Drogue and the Main,s SM model RIM-67A recently made for the L3 Certification.
First the opening of the model by the center for the ejection of the Drogur and checking of the non-ejection of the Nose Cone prematurely.


Next ejection test of the Nose Cone.
This is secured with 3 nylon screws (shear pins) Ø3 mm that are housed in threaded holes equidistant around the neck of the Nose Cone. These screws must be sheared by the ejection load of the Mains.
This test is important since this system must prevent the premature exit of the Nose Cone at the moment of the ejection of the Drogue, which would cause the simultaneous exit of the Main and the Drogue, sanctioned in a Certification.



11.- Painted and decoration

12.- Launching

The flight would take place in the field of Aerocinca, Alcolea de Cinca, Huesca, Spain, usual field of our SpainRocketry Club and during the next meeting **SRM-2018** to be held at the beginning of September, where it is expected to perform a correct flight opening both the Drogue like the parachutes in the foreseen moments, landing in perfect conditions and if possible near the launching ramp, in such a way that the TAP advisors of TRIPOLI SPAIN, **Mr. José Luis Sánchez and Mr. Paolo Basso or Mr. Josep Maria Garrell** can **certify** the corresponding Level 3 Certificate.

13.- List of materials

Descripción	Fabricante/ Proveedor	Tipo	Ctd
Nose Cone: PNC-7.51	LOC Precision.	Poly-propylene Plastic	1
Airframe tube BT-7.51 Ø 7.51", L=30"	LOC Precision	Crafted (laminado FV)	3
Coupler TCL-7.51	LOC Precision	Crafted (laminado FV)	2
Airframe tube LOC BT-3.00	LOC Precision	Crafted (laminado FV)	1
Mamparo Ø190x10 mm	KLIMA	Plywood	5
Mamparo Ø188x10 mm	KLIMA	Plywood	3
Parachute Ø200cm Rip-stop nylon	KLIMA	semielipsoidal	3
Parachute Drogue Ø55" Rip-stop nylon	Apogee	Standard	1
Plywood 500x250x5 mm	Agulló	Abedul finlandés	3
Plywood 1500x250x5 mm	Agulló	Abedul finlandés	4
Anillo de empuje OD160xID76,2x3 mm	Fabricación propia	Aluminio	1
Anillo retenedor motor OD106xDI75.4x2 mm	Fabricación propia	Aluminio	1
Tornillos cabeza estrella con arandela M5x40	Ferretería	Acero cincado	4
Tuercas de púas rosca M5	Ferretería	Acero cincado	4
Chapa perforada Ø8 de 500x250x1 mm	Ferretería	Acero inoxidable	1
Tejido Fibra de vidrio 166 gr/m2	feroca	Tejido	7
Tejido Fibra de vidrio 25 gr/m2	feroca	Tejido	1
Resina epoxi laminados EPOFER EX 401	feroca	Bote de 1Kg	2
Endurecedor EPOFER E416	feroca	Bote de 160 gr.	2
Z-POXY 30 minute - Rexin & epoxy	TodoHobby	PT-39 - 237 ml	2
Masilla epoxi ***ceys*** 2 componentes	Ferretería	*SUPERBARRA*	1
Tubular Kevlar 12 mm (1/2") 900 kg	SierraFox	Kevlar/Aramide	10
Kevlar strap de 12 mm (7/16") 500 Kg	SierraFox	Kevlar/Aramide	10
Correa tubular plana de nylon de 1500 kg	BEAL	Nylon	12
Flameproof protection FCP-24"x24"	SierraFox	NOmex	1
Eslabón rápido (quick link) Ø7 mm 25KN	Declathon	Acero	2
Eslabón rápido (quick link) Ø8 mm 3.5KN	Ferretería	Acero	2
Ball-bearing swivel SW-8	SierrFox	Acero	1
Rail Button (Unistrut Style)	Aerocon	Delrin	2
Tuercas de púas rosca M6	Ferretería	Acero cincado	2
Pernos en "U" de 8 mm rosca M6	Ferretería	Acero cincado	4
Tuercas con arandela M6	Ferretería	Acero cincado	2
Tornillos M6x40	Ferretería	Acero cincado	6
Varillas roscadas e Ø6 mm 1 m	Ferretería	Acero cincado	4
Tubo de aluminio Ø8 x1 m	Ferretería	Aluminio	2
Tuercas M6	Ferretería	Acero cincado	64
Tuercas autoblocante M6	Ferretería	Acero cincado	30
Tuerca mariposa M6	Ferretería	Acero cincado	10
Arandelas anchas M6	Ferretería	Acero cincado	50
Cáncamo rosca hembra M6	Ferretería	Acero cincado	2

Tornillos rosca madera 4x30	Ferretería	Acero cincado	4
Tornillos cabeza estrella – M4x45	Ferretería	Acero cincado	3
Tuercas de púas rosca M4	Ferretería	Acero cincado	3
Tornillos cabeza estrella M5x10	Ferretería	Acero cincado	24
Tuercas con arandela M5	Ferretería	Acero cincado	24
Tornillos rosca madera estrella 2,5x25	Ferretería	Acero cincado	50
Tornillos rosca madera estrella 3,5x30	Ferretería	Acero cincado	10
Altímetro AltiDuo	Boris du Reau		1
Altimetro SRAlt	M. Morales		1
Safe Eject	M. M.	Aluminio	2
Buzzer de 107 dba	Farnell		1
Pila 9 V	Ferretería		2
Conector Pila	SierraFox		2
Interruptor de tornillo	SierraFox		2
Conectores macho hembra con cable	Electrónica		3
Clemas de conexión	Electrónica		4
Cable rojo/negro 2x0,5 mm (metros)	Electrónica		2

14.- Montage and Release Control Lists

The electronic bay will reach the field completely assembled except for the batteries.

This includes the installation of the igniters and the ejection loads of the lower cover to separate the lower and upper bodies of the fuselage that propitiate the ejection and deployment of the DROGUE.

The igniters and the ejection loads of the upper cover will also be installed for the ejection of the Nose Cone (shear pins) and the main parachutes.

Below is the list of procedures and checks to be performed.

14.1 Checklist of the Recovery System (In Spanish for local helpers)

A.- Montaje final de la Bahía electrónica

1. Comprobar la Tensión de las dos baterías de 9 V antes de instalarlas. Deberán medir al menos 9,3 V.
2. Quitar la tapa inferior de la Bahía *(down)* quitando las palomillas y tuercas de las 4 varillas. Desenchufar los 2 conectores aéreos de los ignitores y el del Zumbador.
   Retirar el tubo fuselaje y colocar las dos baterías enchufándolas en el conector correspondiente de cada una. Asegurar cada una de ellas al soporte con una brida de nylon a través de los orificios previstos al efecto.
3. Colocar nuevamente el tubo fuselaje encajándolo en la tapa superior (up) alineándolo en la marca al efecto asegurándose que los orificios de Ø11 mm están situados en la posición que permita el accionamiento de los interruptores. Enchufar nuevamente los conectores aéreos de los ignitores y el del Zumbador.
4. Situar de nuevo la tapa posterior enfilando las varillas y encajándola en el fuselaje. Verificar nuevamente el acceso a los interruptores. Colocar y apretar las tuercas y las palomillas que actuarán como contratuercas.
5. Efectuar una prueba inicial del funcionamiento de los Altímetros. Primero uno que luego se desconecta, a continuación se prueba el otro y luego se desconecta igualmente.
6. A continuación conectar el lazo del cordón de la zona superior con un extremo de la correa tubular plana de 26 mm más corta (la de 3,55 metros) con un eslabón rápido de 8 mm apretando debidamente su tuerca.
7. Deslizar todo el conjunto de correa y cordón por la parte inferior de la Sección 4 (bahía de carga de los Mains) Sacar todo por delante estirando el cordón.
8. A continuación introducir la parte superior de la Bahía, en dicha Sección 4, situando la marca externa de ensamblaje y alineando los orificios para atornillar los 12 tornillos M5x10 de unión.

B.- Montaje de Paracaídas MAIN y cordaje correspondiente

1. Plegar y enrollar cada uno de los 3 paracaídas protegiendo cada de uno de ellos con un paño ignifugo de 12x12" enganchando los tres cordones de suspensión en un eslabón rápido (quick link) de 7 mm y 25 KN junto al cordón de la Ojiva y al otro extremo de la correa tubular plana de 3,55 m.
2. Introducir el embolo ignifugo atando su cordón a la correa tubular y a continuación los 3 paracaídas juntos con sus protecciones "emparejados" hasta el fondo de la Sección 4. A continuación plegar la correa tubular en Zig-Zag sujetándola con una goma elástica floja e introducirla junto con el cordón de la Ojiva.
3. Introducir y situar la Ojiva, según la señal marcada, de manera que coincidan los orificios para los Shear Pins de 2 mm y proceder a atornillarlos.

C.- Montaje de las Secciones 1 y 2

1. Introducir un extremo de la correa plana de 26 mm y 7,5 metros por el interior de la Sección 2 desde la boca superior hasta que sobresalga por la inferior..
2. Conectar el extremo anterior al lazo del cordón tubular de la Sección 1 motriz que ya estará previamente fijado a los cáncamos de esa sección.
3. Introducir el acoplador de la Sección 2 en la boca de la Sección 1, situando la marca externa de ensamblaje y alineando los orificios para atornillar los 8 tornillos M5 de unión.

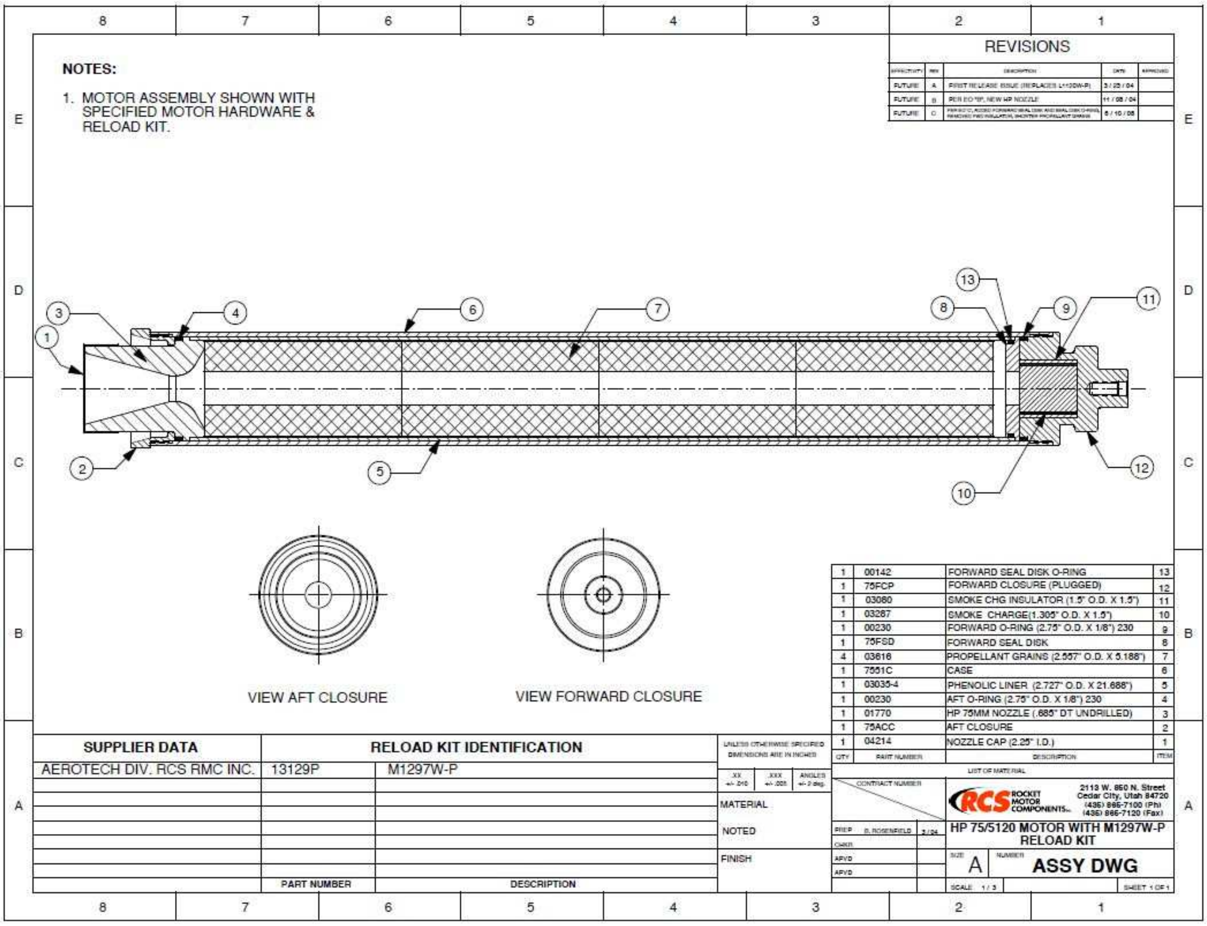
D.- Montaje del DROGUE y cordaje correspondiente

1. Plegar y enrollar el paracaídas DROGUE protegiéndolo con un paño ignifugo de 18x18" (Nomex) enganchando el cordón de suspensión a un eslabón rápido de 7 mm y 25 KN junto a extremo superior de la correa tubular plana de 26 mm de 7,5 metros anterior.
2. Plegar la correa plana de 26 mm en Zig-Zag sujetándola con una goma elástica floja e introducirla junto con el cordón en la bahía de carga de la Sección 2.
3. Introducir el embolo ignífugo atando su cordón al del amarre inferior de la Bahía y luego el paquete del DROGUE enfilando los picos del paño hacia debajo de manera que la parte plana quede arriba protegiéndole de los gases de eyección.
4. Introducir el acoplamiento inferior de la Bahía electrónica en la Sección 2 alineándola con las señales al efecto.

E.- Engine assembly

1. The specific assembly instructions of the selected Aerotech engine will be followed.

Aerotech M1297W-P motor assembly instructions



HIGH-POWER RMS™ Assembly and Operation Instructions

READ THIS BEFORE YOU BEGIN:

- Study the illustrations and sequence of assembly. ***THE SEQUENCE OF ASSEMBLY IS EXTREMELY IMPORTANT.*** **READ ALL INSTRUCTIONS BEFORE USE. USE RMS™ MOTORS AND RELOAD KITS ONLY IN ACCORDANCE WITH ALL INSTRUCTIONS.** Review the parts list and become familiar with all parts before assembly. **IF ANY PARTS ARE MISSING OR DAMAGED, CONTACT RCS AT 1-435-865-7100 or email at warranty@aerotech-rocketry.com.**
- ***DO NOT USE ANY PARTS OF THE RMS™ SYSTEM THAT ARE DAMAGED IN ANY WAY.*** If in doubt, contact RCS at the number above for assistance.
- ***DO NOT MODIFY THE MOTOR IN ANY WAY.*** Modification of the motor or the reload kit parts could result in motor failure, lead to the destruction of both your rocket and motor and may cause personal injury, death and/or property damage. Modification of the motor or reload kit in any way will invalidate your motor warranty.
- ***USE ONLY AEROTECH/RCS RMS™ RELOAD KITS AND MOTOR PARTS TO REFURBISH YOUR RMS™ MOTOR.*** The AeroTech/RCS reload kits have been designed specifically for use in your particular AeroTech/RCS RMS™ motor. Use of imitation components may destroy your motor, rocket and payload and will invalidate your motor warranty. Only use AeroTech/RCS RMS™ reload kits intended for your specific AeroTech/RCS RMS™ motor. ***DO NOT INTERCHANGE PARTS!*** Do not use AeroTech/RCS RMS™ reload kits or motor components for any other purpose than to refurbish an AeroTech/RCS RMS™ motor.
- ***DO NOT REUSE ANY OF THE DISPOSABLE PARTS OF THE RMS™ RELOAD KIT.*** This includes the liner, nozzle and o-rings. These components have been designed for one use only and must be discarded after firing. Reuse can result in motor failure during subsequent operation and will invalidate your motor warranty.
- Motors are hot after firing. Although the RMS™ operates at a lower temperature than most disposable motors, the higher thermal conductivity of the aluminum motor parts may make it seem otherwise. If necessary to handle a motor before it has cooled down, use a rag or similar article.
- Read and follow the safety code of the Tripoli Rocketry Association (TRA) and comply with all federal, state and local laws in all activities involving high power rockets.

DO NOT OPEN RELOAD KIT UNTIL READY TO USE.

PARTS:

RMS™-75 HARDWARE

75mm aft closure	1
75/5120 case	1
75mm plugged forward closure	1
75mm forward seal disk	1

RELOAD PARTS KIT

Nozzle (large black plastic part)	1
Liner (2-3/4" O.D. black plastic tube)	1
Propellant grains (7/8" core)	4
Fwd & aft o-rings (1/8" thick X 2-3/4" O.D.)	2
Forward seal disk o-ring (3/32" thick x 2-9/16" O.D.)	1
Grain spacer o-rings (1/16" thick x 2-1/2" O.D.)	3
Smoke charge (short solid part)	1
Smoke charge insulator (1-1/2" O.D. tube)	1
Nozzle Cap (2-1/4" dia. red cap)	1

ITEMS NEEDED FOR USE:

- Synco™ Super Lube™ or other grease
- Hobby knife
- Electric match w/thermalite, Firestar™ or other igniter
- Masking tape
- Wet wipes or damp paper towels

SAVE THE RELOAD KIT PLASTIC BAG FOR THE USED RELOAD PARTS. DISPOSE OF BAG AND PARTS PROPERLY.

Chapter 1. Forward Closure Assembly

1-1. Apply a light coat of Synco™ Super Lube™ or other grease to all threads and all o-rings (**except** the grain spacer o-rings). This will facilitate assembly and prevents the threads from seizing.

1-2. **Fig.-1:** Hold the forward (black) closure in a vertical position, smoke charge cavity facing up. Insert the smoke charge insulator into the smoke charge cavity until it is seated against the forward end of the cavity.

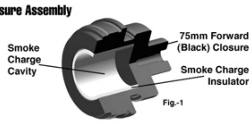


Fig.-1

1-3. **Fig.-2:** Apply a liberal amount of grease to one end of the smoke charge element. Insert the **greased** end of the smoke charge element into the smoke charge cavity until it is seated against the end of the cavity. Set the completed forward closure assembly aside.

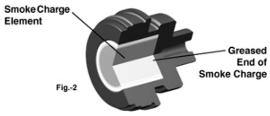


Fig.-2

Chapter 2. Case Assembly

2-1. **Fig.-3:** Using a hobby knife or similar tool, carefully deburr (chamfer) both inside edges of the liner tube (2-3/4" O.D. black plastic tube).

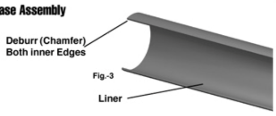


Fig.-3

Chapter 2. Case Assembly (Cont'd)

2-2. **Fig.-4:** Insert the larger diameter portion of the nozzle into one end of the liner, with the nozzle liner flange seated against the liner. **NOTE:** RMS-75/5120 motors use a single large throat nozzle rather than the multiple-throat "Medusa" nozzle shown in the illustrations.

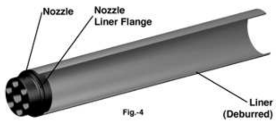


Fig.-4

2-3. **Fig.-5:** Perform the remaining assembly steps with the liner held in a horizontal position. Install the propellant grains into the liner, placing the three (3) grain spacer o-rings (1/16" thick x 2-1/2" O.D.) between each propellant grain. The aft grain should be seated against the nozzle grain flange. **NOTE:** Three propellant grains are shown in all illustrations for simplicity. RMS-75/5120 motors use four (4) grains.

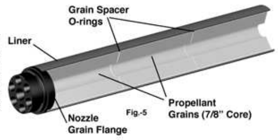


Fig.-5

2-4. **Fig.-6:** Place the greased forward seal disk (3/32" thick X 2-9/16" O.D.) o-ring into the groove in the forward seal disk.

Fig.-6

2-5. **Fig.-7:** Insert the smaller (o-ring) end of the seal disk into the open end of the liner tube until the seal disk flange is seated against the end of the liner.

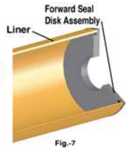


Fig.-7

2-6. **Fig.-8:** Push the liner assembly into the motor case until the nozzle protrudes approximately 1-3/4" from the end of the case. **NOTE:** A coating of grease on the outside surface of the liner will facilitate installation and casing cleanup after motor firing.

Fig.-8

2-6. **Fig.-9:** Place the greased forward (1/8" thick X 2-3/4" O.D.) o-ring into the forward (bulkhead) end of the case until it is seated against the forward seal disk.

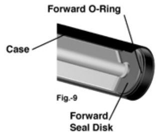


Fig.-9

2-7. **Fig.-10:** Thread the previously-completed forward closure assembly into the forward end of the motor case by hand until it is seated against the case. **NOTE:** There will be considerable resistance to threading in the closure during the last 1/8" to 3/16" of travel.

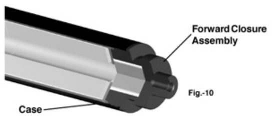


Fig.-10

2-8. **Fig.-11:** Place the greased aft (1/8" thick X 2-3/4" O.D.) o-ring into the groove in the nozzle.

2-9. **Fig.-12:** Thread the aft closure into the aft end of the motor case by hand until it is seated against the case. **NOTE:** There will be considerable resistance to threading in the closure during the last 1/8" to 3/16" of travel. It is normal if a slight (1/32" to 1/16") gap remains between the closure and the case, and the grains rattle slightly in the liner after tightening.

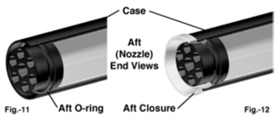


Fig.-11 Fig.-12

Chapter 3. Preparation For Flight

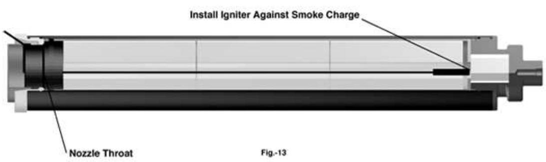


Fig.-13

3-1. **Fig.-13:** Insert the coated end of a Firestar™ or other igniter through the nozzle throat until it stops against the smoke charge element.

3-2. Secure the igniter to the nozzle with a piece of masking tape or the 2-1/4" dia. red nozzle cap supplied with the reload kit. NOTE: Cut a 1/8"-1/4" wide slot in the corner of the cap to allow for igniter venting.

3-3. Install the motor into the rocket's motor mount tube. Ensure that the motor is securely retained in the rocket by using positive mechanical means to prevent it from being ejected during recovery system deployment.

3-4. Prepare the rocket's recovery system and then launch the rocket in accordance with the Tripoli Rocketry Association (TRA) Safety Code and National Fire Protection Association (NFPA) Code 1127.

Chapter 4. Post-Recovery Cleanup

NOTE: Perform motor clean-up as soon as possible after motor firing. Propellant and smoke charge residues become difficult to remove after 24 hours and can lead to corrosion of the metal parts. Place the spent motor components in the reload kit plastic bags and boxes and dispose of properly.

4-1. After the motor has cooled down, unthread and remove the forward and aft closures.

4-2. Remove the smoke charge insulator from the forward closure and discard. Using wet wipes or damp paper towels, remove all smoke charge and propellant residues from the closures.

4-3. Remove and discard the forward and aft o-rings from the motor case. Remove the liner, forward seal disk and nozzle from the casing by pushing on the nozzle end. Remove the forward seal disk from the liner, and remove and discard the forward seal disk o-ring. ***DO NOT DISCARD THE FORWARD SEAL DISK!*** Discard the nozzle and liner. Using wet wipes or damp paper towels, wipe the inside of the casing and the forward seal disk to remove all propellant residue.

4-4. Apply a light coat of grease to all threads and the inside of the motor case. Reassemble metal parts and store motor in a dry place.

Chapter 5. First Aid

WARNING: For a minor burn, apply a burn ointment. For a severe burn, immerse the burned area in ice water at once and see a physician as quickly as possible. In the unlikely event of oral ingestion of the propellant, induce vomiting and see a physician as quickly as possible. The AeroTech/RCS composite propellant consists primarily of Ammonium Perchlorate and a rubber-like plastic elastomer.

Chapter 6. Disposal

Damaged or defective reload kits should be returned to RCS.

Chapter 7. Fire Safety

Tests show that the pyrotechnic components of RMS™ reload kits will not explode in fires and normally will not ignite unless subjected to direct flame and then will burn slowly. Use water to fight any fires in which AeroTech/RCS RMS™ reload kit pyrotechnic components may become involved: Direct the water at the AeroTech/RCS RMS™ reload kit pyrotechnic components to keep them below their 550 deg. F autoignition temperature. Foam and carbon dioxide fire extinguishers will NOT extinguish burning propellants of the type used in RMS™ reload kit pyrotechnic components. Keep reload kit pyrotechnic components away from flames, sources of heat and flammable materials.

Disclaimer and Warranty

NOTICE: As we cannot control the storage and use of our products, once sold we cannot assume any responsibility for product storage, transportation or usage. RCS shall not be held responsible for any personal injury or property damage resulting from the handling, storage or use of our product. The buyer assumes all risks and liabilities therefrom and accepts and uses AeroTech/RCS products on these conditions. No warranty either expressed or implied is made regarding AeroTech/RCS products, except for replacement or repair, at RCS's option, of those products which are proven to be defective in manufacture within one year from the date of original purchase. For repair or replacement under this warranty, please contact RCS. Proof of purchase will be required. Note: Your state may provide additional rights not covered by this warranty.

AeroTech Division
RCS Rocket Motor Components, Inc.
Cedar City, UT 84721
www.aerotech-rocketry.com

P/N 20082-1 Rev. 11/17/09
Made in U.S.A.

AEROTECH® CONSUMER AEROSPACE
Division of RCS Rocket Motor Components, Inc.

HIGH-POWER RMS™
Reloadable Motor System™
RMS™ 75/5120 WHITE LIGHTNING™

This Package Contains One Reload Kit:

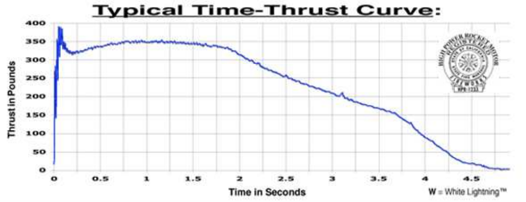
☐ ***M1297W-P*** (75/5120)

NOTE: This reload kit MUST be used with separately packaged White Lightning™ propellant grains (P/N 03616) and motor liner tube (03035-4). RMS™-75 reload kits do not include an ejection charge. RMS-75 motors must be used in conjunction with a timer, altimeter or radio-actuated recovery system.

NOTE: This reload kit is *ONLY* for use in AeroTech/RCS, Rouse-Tech™ or Dr. Rocket™ RMS™ 75/5120 high-power motors. Certified by the Tripoli Rocketry Association (TRA).

DO NOT OPEN RELOAD KIT UNTIL READY TO USE

Typical Time-Thrust Curve:



RMS™ 75MM WHITE LIGHTNING RELOAD KIT DATA

Hardware Designation	Performance Designation	Total Impulse (Typical)	Propellant Weight	Loaded Motor Weight
RMS™-75/5120	*M1297-P*	5,417 N-sec	2,681 g (5.91 lb)	4,708 g (10.37 lb)

RMS™ 75MM HARDWARE DATA

Hardware Designation	Motor Diameter	Motor Length	Hardware Weight	Reload(s) Used
RMS™-75/5120	2.965" (75mm)	26.20"	1,408 g (3.10 lb)	M1297W-P

NOTE: Motor lengths are measured from end of aft closure to end of forward closure.

NOTE: SALE TO PERSONS UNDER 18 YEARS OF AGE PROHIBITED BY FEDERAL LAW. WARNING-FLAMMABLE: Read Instructions Before Use. KEEP OUT OF REACH OF CHILDREN. FOR USE ONLY BY CERTIFIED HIGH-POWER USERS 18 YEARS OF AGE OR OLDER. DO NOT SMOKE when loading these motors or use in the vicinity of open flames.

2. Next, the retaining ring of the motor mount tube will be removed, unscrewing the 4 M5x40 screws, the motor will be introduced until the rear closing rests on the metallic Push-on Ring and later the retaining ring will be replaced by screwing the four screws.

14.2.- Pre-flight Control List in Ramp (Pre-flight On-Pad Checklist)

DESCRIPCIÓN	Control
1. Situar el cohete sobre las borriquetas al efecto y revisar fijación de la Ojiva, ensamblaje de la Sección 3 (bahia-e) en la Sección 2 inferior.	
2. Introducir el cohete en la rampa.	
3. Elegir orientación e inclinación de la rampa.	
4. Comprobar que no se haya instalado ningún ignitor en el motor.	
5. Comprobar que la Centralita de Lanzamiento está en "off" y/o con el Lanzamiento desabilitado.	
6. Conectar, atornillando, el interruptor "A" del Sistema electrónico 1, Altiduo. Un pitido largo y 3 breves indica la versión: 1.3 1 Pitido largo indica que uno de los ignitores no está conectado 2 pitidos largos indican que ambos ignitores no están conectados 2 pitidos cortos indican que ambos ignitores si están conectados, Ok Luego emitirá 1 Pitido repetitivo indicando continuidad Ok	
7. Conectar, atornillando, el interruptor "B" del Sistema electrónico 2, SRAlt. Mediante pitidos dará datos: corto unidades, largo cero. Emitirá la altura del último apogeo alcanzado (se repite tres veces) Pitido largo de 1 kHz (tono distinto) Escuchar la secuencia de encendido del SRAlt: Altura programada para la apertura del Main Pitido largo de 1 kHz (tono distinto) Retardo programado para la opción de Mach Pitido largo de 1 kHz (tono distinto) 3 pitidos repetitivos indican: SRAlt y continuidad de ambos ignitores Ok.	
8. Si hay cámaras de vídeo *on-board*, activarlas.	
9. Instalar ignitor en el motor.	
10. Cortocircuitar las pinzas de conexión de la centralita.	
11. Conectar el ignitor a la centralita.	
12. Indicar al LCO que el cohete y la centralita están "ready".	
13. Al recibir la indicación del LCO, habilitar el lanzamiento desde la centralita (eliminar seguridad).	

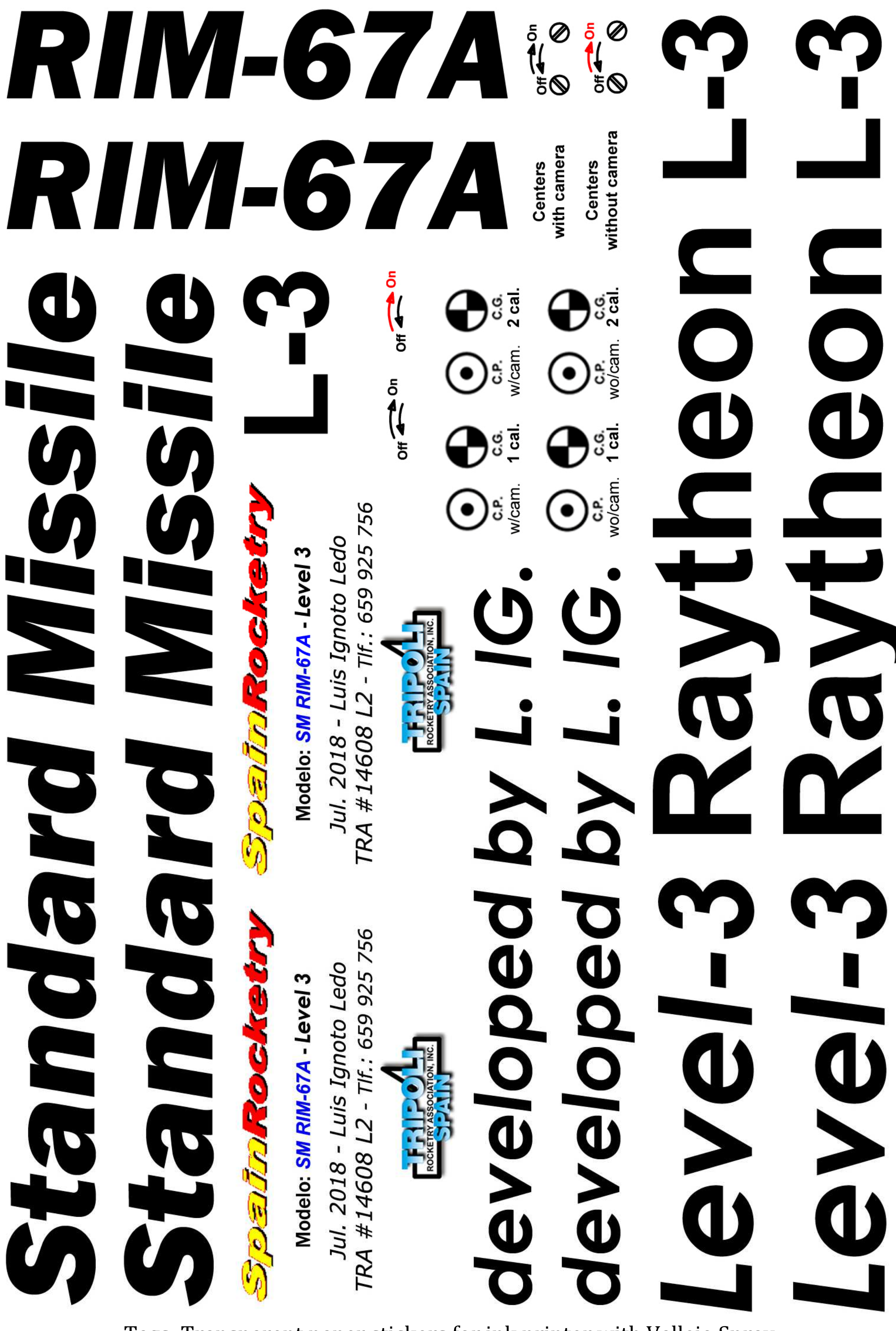
15.- TRA Pre-flight Capture Form

Tripoli Advisor Panel Pre-Flight Data Capture Form

ROCKETRY ASSOCIATION, INC.

NAME: LUIS IGNOTO	ADDRESS: Calle Alto del Arenal,5 - 28(	PHONE #: +34659925756
TRA #: 14608	LAUNCH LOCATION: Alcolea de Cinca, Spain	DATE: Sep 8, 2018
ROCKET SOURCE: KIT ☑ SCRATCH ☑	ROCKET NAME: SM RIM-67A	COLORS: White, Black & Red
ROCKET DIAMETER: 7.71"=(7.51"+FV) (196mm)	ROCKET LENGTH: 112.88" (2867 mm)	ROCKET WEIGHT LOADED: 724 oz (20.529 Kg)
AVIONICS DESCRIPTION: SRAlt Altimeter AltiDuo Altimeter	MOTOR TYPE: M1297W P / Aerotech	THRUST TO WEIGHT RATIO: 6.65:1
LAUNCHER REQUIREMENTS:	LENGTH: 10 ft	
CENTER OF PRESSURE: 89" (2260 mm)	HOW CALCULATED: OpenRocket Simulator	
CENTER OF GRAVITY: 73.35" (1863 mm)	HOW CALCULATED: OpenRocket Simulator	
MAXIMUM VELOCITY: 207 m/s (Mach 0.62)	HOW CALCULATED: OpenRocket Simulator	
MAXIMUM ALTITUDE: 5581 ft (1701 m)	HOW CALCULATED: OpenRocket Simulator	
WAS FLIGHT SUCCESSFUL:	YES: ☐	NO: ☐
TAP NAME:	Josep María Garrell	
TAP NAME:	Jose Luis Sanchez	
TAP NAME:		

16.- <u>Labels</u> A set of decorative adhesive decals is included below.



Tags: Transparent paper stickers for ink printer with Vallejo Spray

Added post-launch

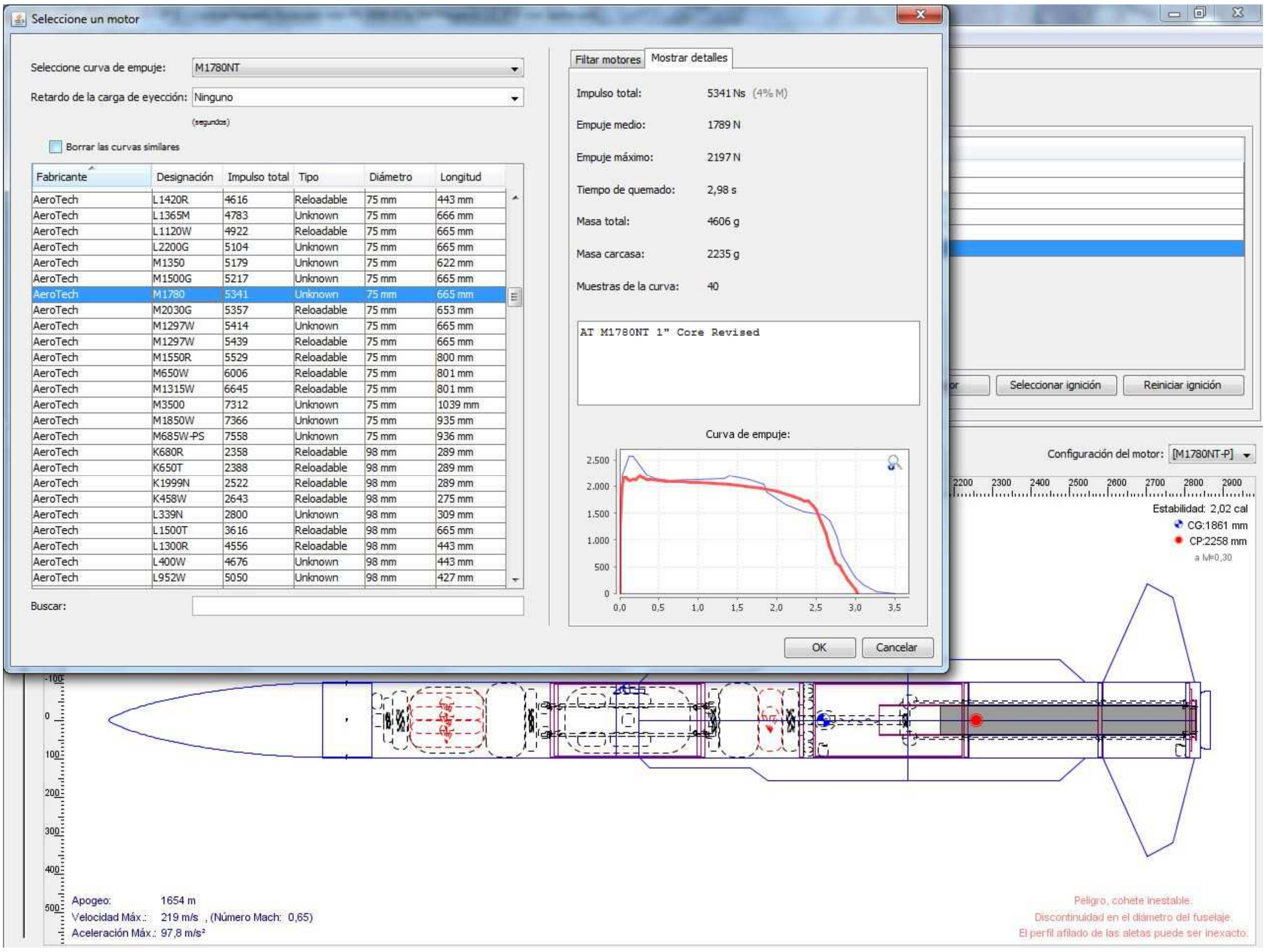
17.- Engine change and Launch

17.1.- Engine change

Ten days before the SRM-2108 meeting, I was informed that the planned engine, the **M1297W**, is not available from our supplier in Europe and instead I am offered an M1315W with 25% more total boost, but later offer an **M1780NT Blue Thunder**, Impulse similar to the planned engine although a little more "spirited", since it burns in 3 seconds while the other does in 4 seconds, which results in a stronger start and therefore a greater acceleration, about 10 g's .

As this seems acceptable to me by both the Simulation and the structure of the model. I consult with my TAP Josep María agreeing with me about this, which accepts the offer of said engine **M1780NT**.

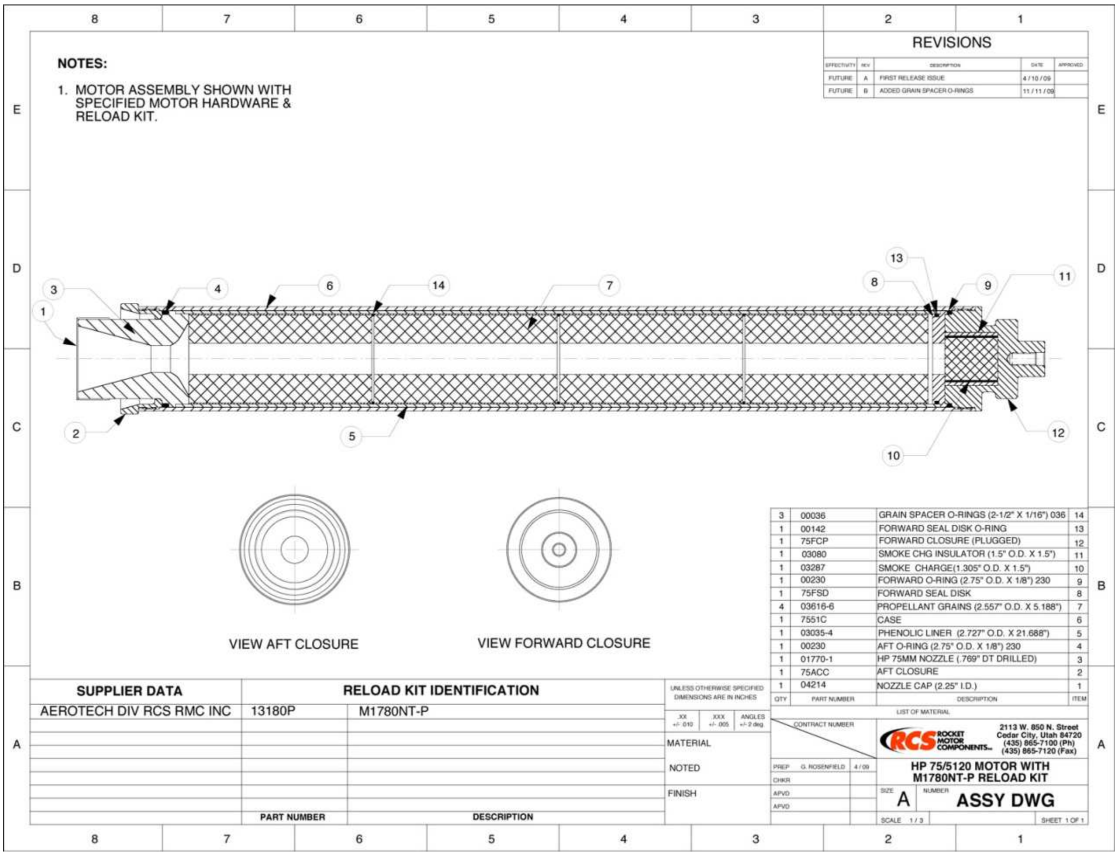
As a result, the simulation, which gives a predictable altitude of 1652 meters, is incorporated into the annexed document on the day of the launch together with the Assembly plan, which is practically the same as the M1297W, and which I will add here below.

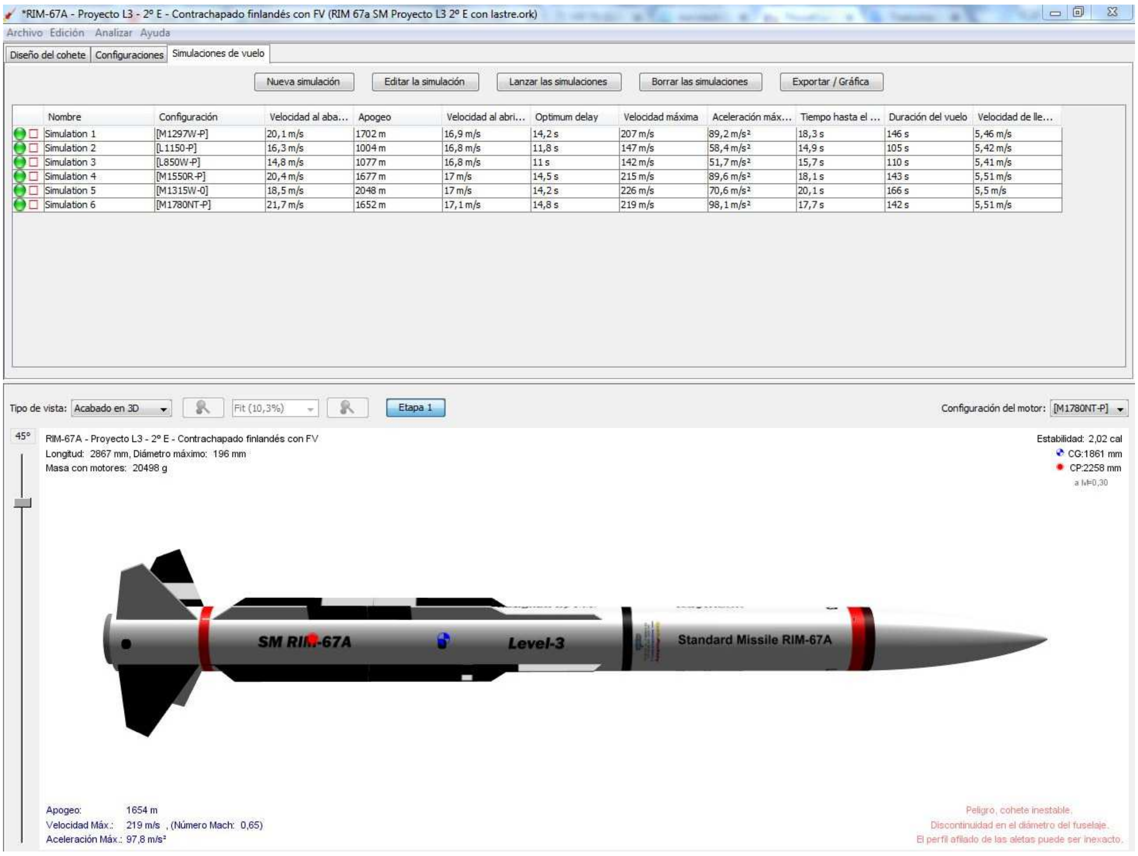


Characteristics of the M1780NT engine:

Total impulse	6341 Ns	Medium thrust	1789 N	Maximum thrust	2179 N
Burning time	2.98 s	Total mass	4606 g	Mass housing	2235 g

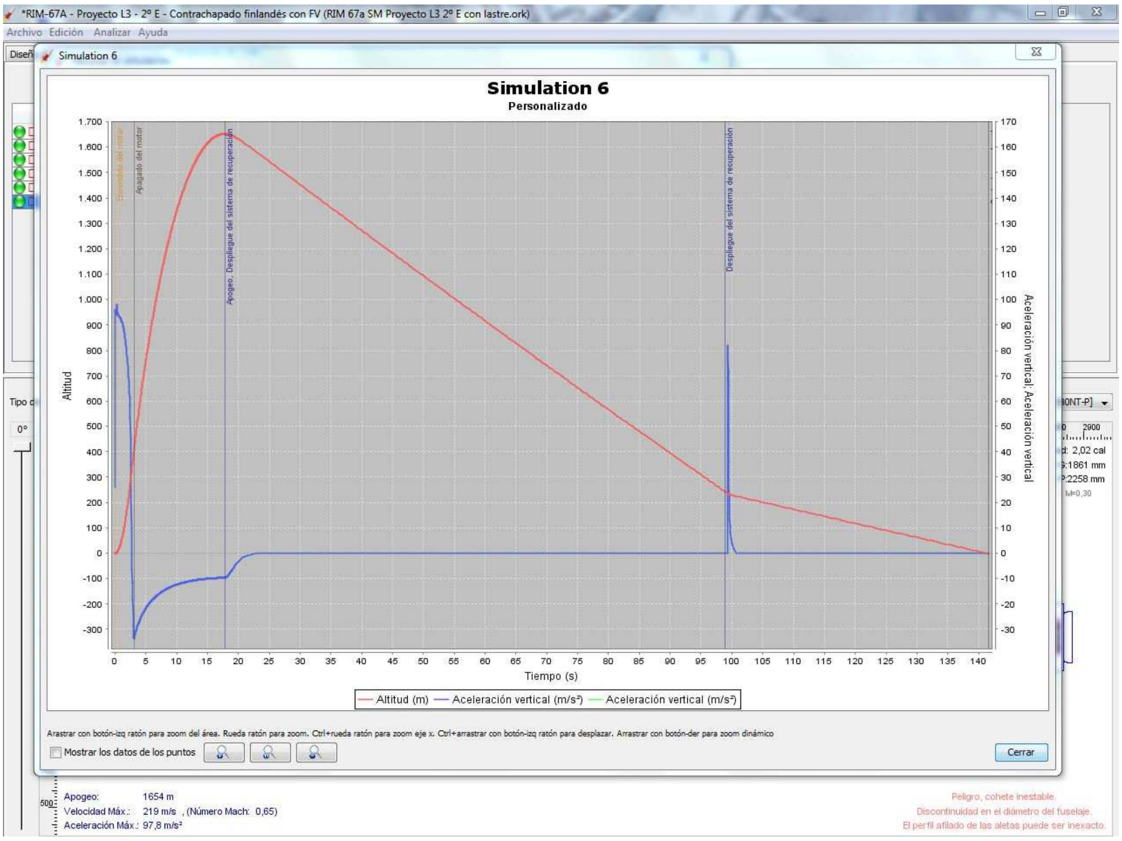
The differences with the M1297W are minimal except for the burning time and a greater acceleration that actually favors a more vertical takeoff, counteracting the influence of the possible wind.





Design and calculation with M1780NT engine

Simulation # 6 presents the expected data that is only slightly lower in Altitude, 1652 vs. 1702 m, and in terms of maximum acceleration: 98 m / s2 vs. 89 m / s2. The rest is similar.



Altitude-Vel-Acceleration engine M1780NT

17.2.- Launching

In Aerocinca, Alcolea de Cinca, Huesca, at the annual International Meeting of our *SpainRocketry* Club, the **S.R.M.-2018** scheduled from September 7 to 9, 2018, I set out to try the L3 Certification of Tripoli Rocketry Association.

On Friday the 7th we arrived at about midday at Aerocinca, my wife Charo, my son Gonzalo and I with the car packed to the brim with the 4 sections of the SM RIM-67A model and everything necessary, Not having enough space available in the car, we had to use a roof trunk (provided by my son).

The model is basically *custom* scaling of the missile of the same name but adapting its measurements to the available material, from LOC Precision, and above all to ensure maximum aerodynamic stability.

That day we dedicate it to review the state of the pieces after the trip and pre-assemble Section 1 motor with Section 2, which make up the lower half of the model, and that along with the Electronic Bay and the rest of the parts of the model We keep in the container that the organization usually has to store material from one day to the next.

On Saturday 8th with the presence of the TAP Josep María Garrell we set to assemble the model following the steps of the Check List starting with the electronic Bay that had already pre-installed the 2 altimeters, an acoustic Buzzer connected to one of the altimeters for signaling in fall and the necessary loads for the ejection of the Drogue and the 3 Main's parachutes.

Once a GPS tracking device was incorporated, the batteries were placed and the operation of all the electronics was verified at first, we proceeded to assemble the whole model including two video cameras on board: one focusing towards the ground destined to record the deployment of the Drogue as well as the flight field and the other towards the front destined to record the deployment of the 3 main parachutes.

With the collaboration of two young rockerers (Albert and Dani) the model is moved to the presence of the LCO and RSO in the vicinity of the PAD to proceed with its verification and launch.

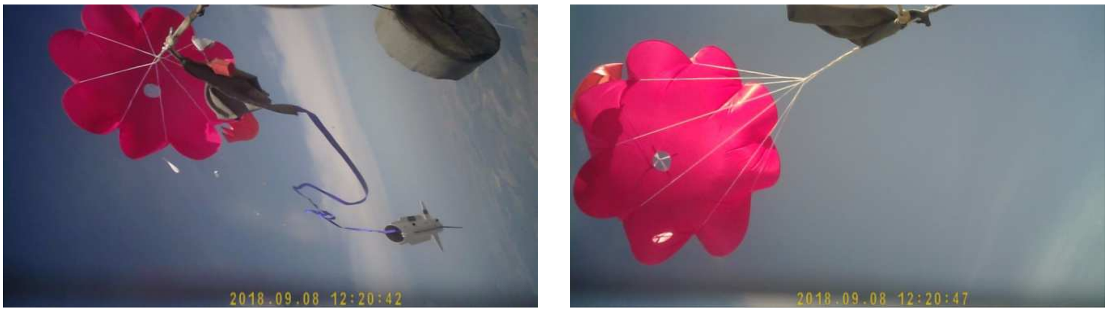
Photo of Romuald Coutenceau

And once all the verifications were done, we proceeded to the Launch: 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, GO …

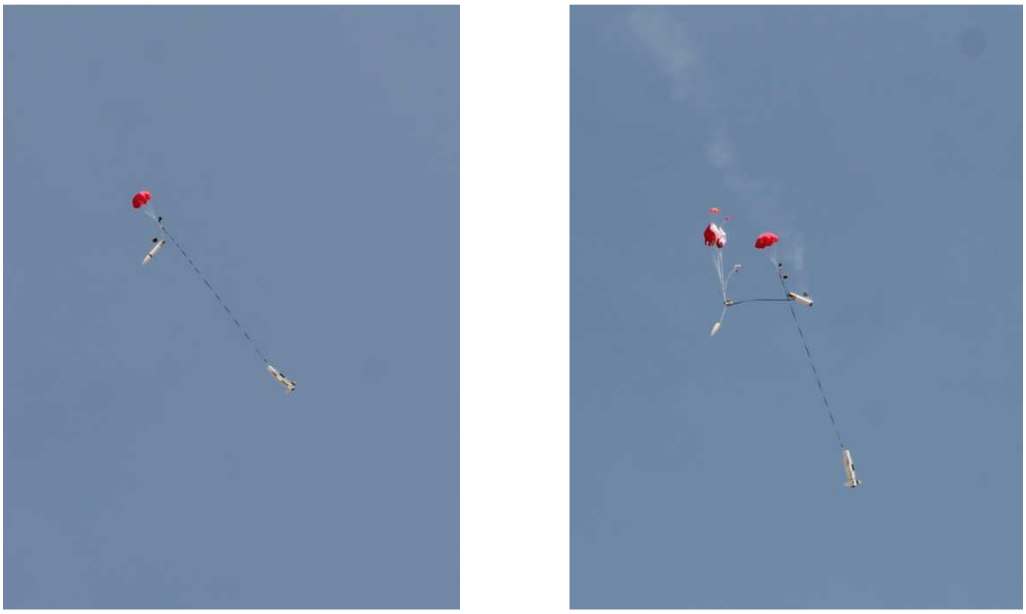
Foto de Iban Perez

With a rumble typical of the Blue Thunder engines and its characteristic bluish color makes a majestic climb by burning the engine during its 3 seconds reaching Mach 0.65 <> 789 Kmh and continuing a perfect inertial vertical flight until reaching the Apogee at 1,617 meters at 18.7 sg of climbing in total. Automatically ejects the Drogue parachute and begins a descent for 96 sg at 14.5 m/s up to 250 m altitude where according to the programmed ejects the main parachutes that reduce the speed of fall to about 5.5 m/s (about 20 kmh) arriving 36 sg later to the ground being verified his integrity by the TAP present D. Josep Maria Garrell that later proceeded to the signature of the L3 certificate, as well as the RSO of the meeting and Prefect of the Club D. José Luis Cortijos.

APOGEE: 1.617 m (5,305 ft)



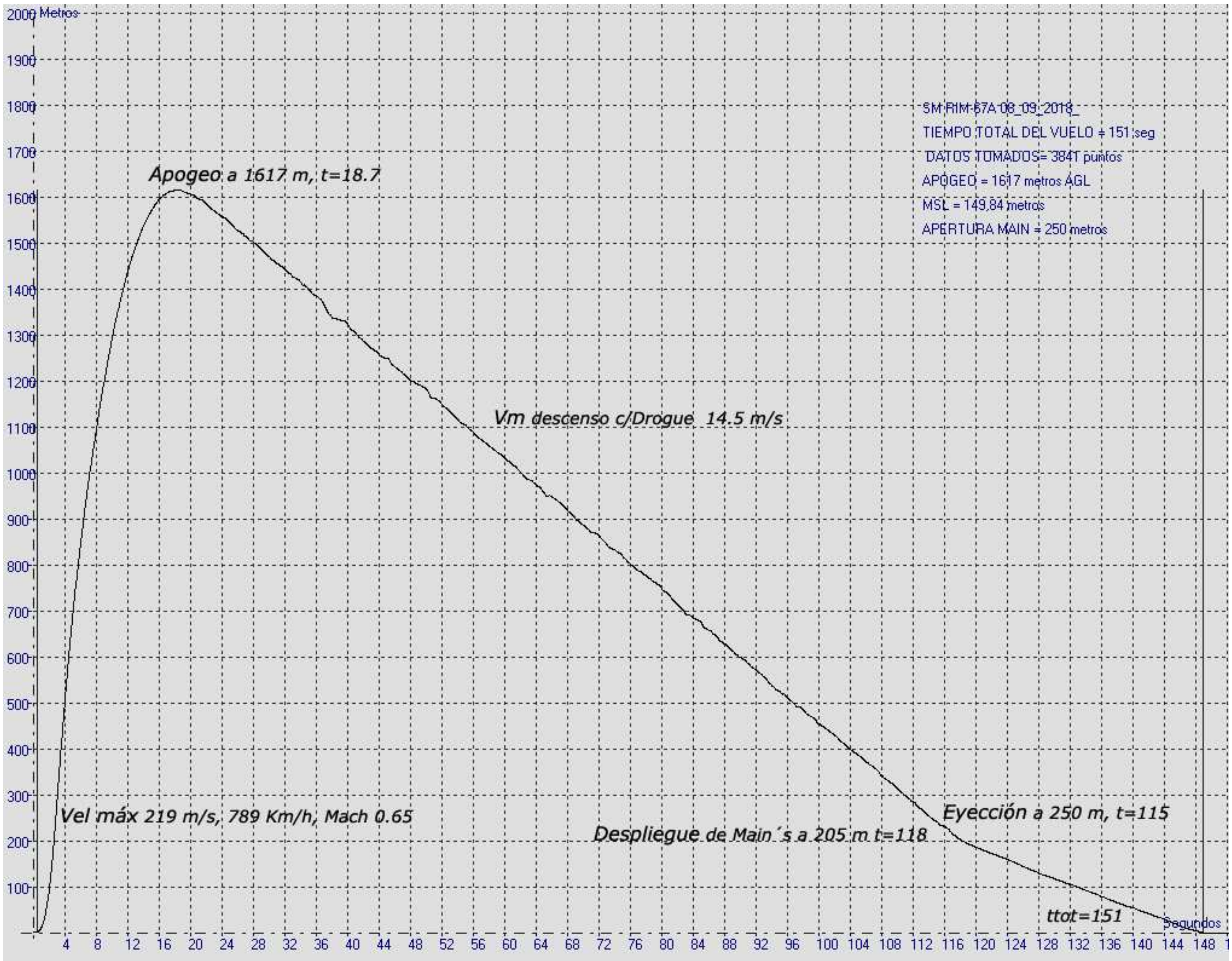
Deployment of the Drogue parachute (Frames on the lower board)



Descent with the Drogue and subsequent start of ejection of the Main's (photos by Alejandro Amor)

Landing: All the parachutes deployed with their respective pilot parachutes.

Photos of Romuald



Real graph of the flight registered by Altimeter 2, a SRAlt of M. Morales

18.- Acknowledgments

There are so many that I have to thank, some of their support, others their teachings and others their help and collaboration both in the preparation of the model as in the transfer to ramp and its release, as well as the large amount of photographic material that they have given me of excellent quality, that I am afraid to relate them because surely that one will happen to me. If so, forgiveness.

In principle to all the Members of the SpainRocketry Club, especially to its Prefect and RSO of the *José Luis Cortijos* meeting, to *Jaume Solé* as LCO, as well as to the TAP of the same who have advised me at all times since the beginning of the project, *Paolo Basso* (although later he could not attend the Launch), *Josep María Garrell* checking all the details, as well as *José Luis Sánchez*, the veteran and first L3 of the Club.

To *Manuel Morales* for his advice, his altimeter SRAlt his solution Buzzer and his collaboration with the assembly in the field.

To *Albert Garrell, Dani* and *Paco Romero* as "porters" of the model up to the ramp and PAD Managers like *David Sariñena* and *Josep María* himself.

To *Gonzalo Ignoto, Rosario Nicolás, Alejandro Amor, Iban Pérez, Romuald Coutenceau, Paco Romero, Josep María* ... for the photographic material.

To *Joaquim Gaya Beltran* (current L3) friend and veteran teammate since the CIAM-FAI Competition, when together with Alberto Marina Alonso and Team Leader Ángel Infante Moratilla we won a Gold Medal for teams and I won an individual medal in the category S3A at the WSMC-1980 of Space Modeling in Lakehurst, NJ USA. (see chapter 2.1), in whom I have been inspired for this stage following his steps in the High Power Space Modeling, since 2011.

To my friend and companion *Jesús Manuel Recuenco Andrés* who located me through the Internet in 2011 inviting me to meet with the group from the Madrid area, of which he is the Club Representative, and give me the opportunity to meet again with the ME, this time in the highest facet, the High Power Rocketry (H. P.R.)

And finally to my family: *Rosario Nicolás (Charo*) my self-sacrificing wife, to my children *Alberto, Marima*r and *Gonzalo* for their support and interest.

The latter especially on this occasion to accompany me (and drive 90% of the time), to provide me with the boot trunk for the car and mount it, for giving me the idea and computer support to the model's location system and also for acting as an assistant and camera during the whole meeting.

Anyway, as I said before, also to all those who I will not have mentioned my thanks.

Luis Ignoto Ledo, TRA #14608 – L3 (at present) october, 2018