Ciel d'Octobre 2026 Workshop

September 29th and 30th, 2026

Dara R. Samii

Space Concordia Solid Rocketry

Intro

Membership

Exam

Design with OpenRocket

Purchasing and manufacturing

Launch day

Welcome to Ciel d'Octobre 2026

Design. Build. Certify. Fly.

- Your own high power rocket, built this term
- Certification flight at Ciel d'Octobre, Oct 17 and 18
- Help from team members who already hold L1 or higher

Today: memberships, exam, design, parts, build.



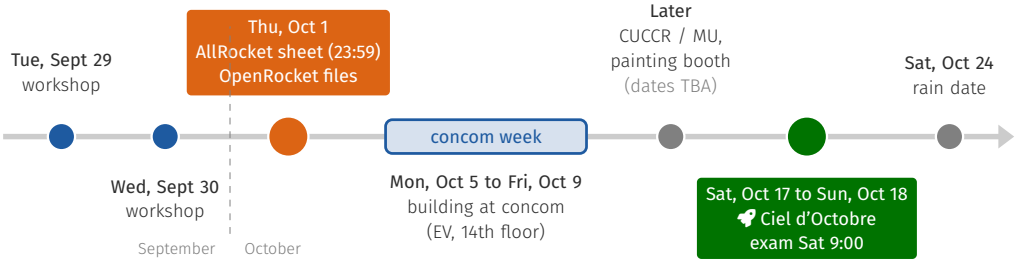






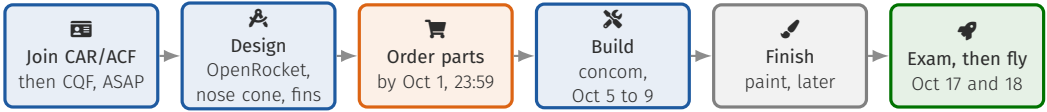
Photos: Ciel d'Octobre, previous edition.

Calendar



Ciel d'Octobre: Ste-Pie-de-Guire (Québec). Event page (car-acf.org): pending authorizations.

Your path from today to the launch pad



Study for the exam in parallel, starting this week.

Workshop material

All workshop material is in this Google Drive folder. Slides will be shared there later.

Ciel d'Octobre 2026: workshop folder (Google Drive)

drive.google.com/drive/u/2/folders/1rTv49G4ooVQJI6dzQXln1-thD2EdoHf_

Workshop folder

Intro

Membership

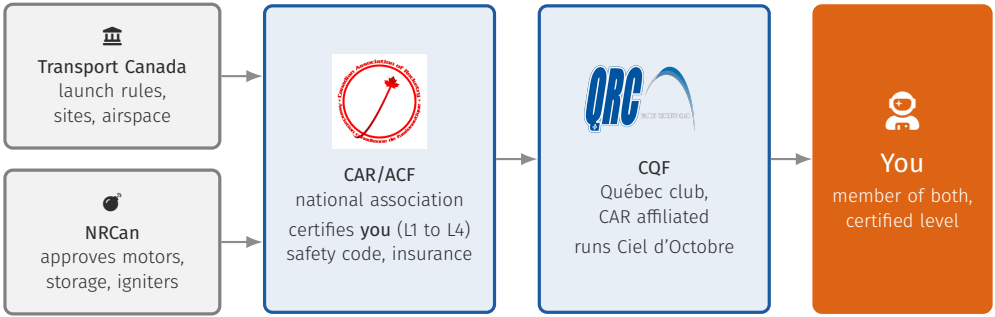
Exam

Design with OpenRocket

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Who lets you fly a high power rocket?



Based on the Transport Canada letter of 21 June 1999 (handbook annex) and last year's deck.

CAR/ACF: why you need it



Canadian Association of Rocketry
/
Association canadienne de fuséonautique

What it does

- Runs the high power certification program (Levels 1 to 4)
- Publishes the HPR Safety Code (v3.6, Feb 16, 2026)
- Insures sanctioned launches

Who must be a member

- Everyone attempting certification: your CAR/ACF number goes on the form
- Every high power participant at Ciel d'Octobre
- Under 18: Junior membership, and a certified senior sponsor handles the motor

CAR/ACF: join

1. Open canadianrocketry.org/en/join-us
2. Choose **Individual Senior** (18+)
3. Fill in the form and pay
4. Save your **member number** and **card** on your phone

At certification: the card **and** a government ID.

$65 / year

Individual Senior: **most of you**

$15 / $80

Junior (under 18) / Family

canadianrocketry.org, checked Sept 29, 2026. Renew every year.

Join CAR/ACF

Sign up ASAP, so you receive your number by the weekend. The QRC form and the certification form both ask for it.

QRC / CQF: join

Québec Rocketry Club /
Club Québécois de Fuséonautique

Runs Ciel d'Octobre: safety, NOTAM, inspectors, launch rails and ignition.

New member: $50

One-day launcher: $40

🔗 Join **CAR/ACF first**: the QRC needs your CAR/ACF number.

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What Level 1 certification checks

1. Theory and knowledge

Written exam: regulations and technical questions.

Oral questions from the Rocket Inspector.

2. Construction

A sound, strong design, well built.

Checked by the Rocket Inspector before flight, and again after landing.

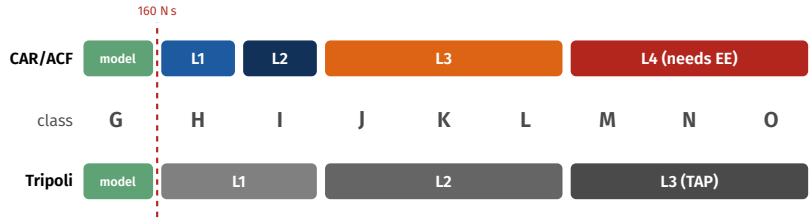
3. Motor handling

Motor handling, assembly and use.

Safe preparation and ignition.

> Your first rocket on an H motor **must** be a certification attempt, on a simple design: one stage, one motor, no payload.

Certification levels

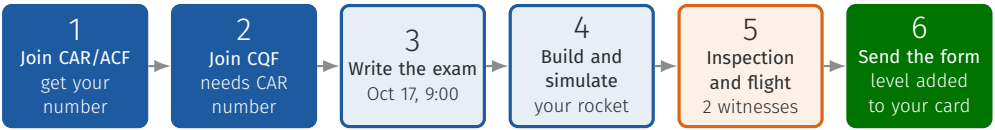


D. R. Samii, *High-Power Rocketry Certification: A Study Companion*, ch. 1 (redrawn in deck colours).

Level	Motors you may buy and fly	Total impulse
L1	H	160.01 to 320 N s
L2	I	320.01 to 640 N s
L3	J, K, L	640.01 to 5 120 N s

Attempts at **L2 and higher** are allowed.

Certification, step by step



Step 6: scan the signed form to memberships@canadianrocketry.org

The written exam

50 questions

multiple choice or fill in the blank, in 2 sections

100 %

Regulations: 25 federal (Transport Canada) questions. Every answer must be right.

75 %

Technical: 25 questions drawn from a pool of **48** study questions

When and how

Saturday, October 17, 9:00, before any flight.
A **calculator** is allowed; the math is easy.
A pass stays valid **1 year** for the flight.

If you fail

You will not launch at this event.
The exam can be taken only once per **30 days**: next try at the next event.

Source: CAR/ACF HPR Level 1 to 3 Certification Program v3.0, Level 1 requirements.

What to study, in priority order

1. **TC practice exam** (25 Q): handbook p. 3 to 5, answers p. 6 to 7
   needs 100 %
2. **CAR/ACF practice exam** (the 48 study questions): p. 8 to 12, answers p. 13 to 15
3. **The TC documents** (box on the right)
4. **CAR/ACF HPR Safety Code v3.6** (2026); the handbook copy is the 2005 edition
5. Explanations: *Study Companion*, ch. 2 and ch. 3

Study material (Google Drive)

Study material

What are the “TC documents”?

TC = **Transport Canada**, which writes the rules. The exam’s regulations part comes from:

1. Requirements for Launching HPR in Canada (p. 17 to 27)
2. Letter of clarification, 1999 (p. 33 to 35)
3. Launch Authorization, Appendix A (p. 36)

Flight requirements per level

Level	Motor	Specific rules
L1	**one H** motor	single motor, no cluster or staging; **no hybrid**
L2	**one I** motor	hybrid only with a CAR/ACF Hybrid Endorsement (or HQ waiver)
L3	**one J, K or L**	single motor; CAR/ACF recommends starting with a J

Motor and rocket

Certified motor, accepted by NRCan.
Reload assembled before a witness.
Thrust to weight at least **4:1**.

Recovery and flight

Stable, recovery deploys, safe landing.
Over 5 kg: redundant deployment.
Any major failure: no certification.

Witnesses

2 witnesses, 18+, members, not related to you.
At least one certified at your level or higher.
In person: video is not accepted.

Intro

Membership

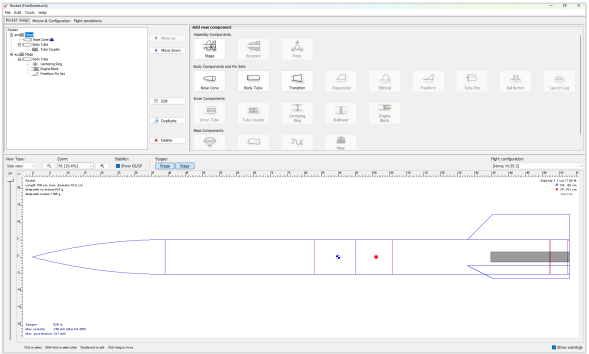
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We design everything in OpenRocket



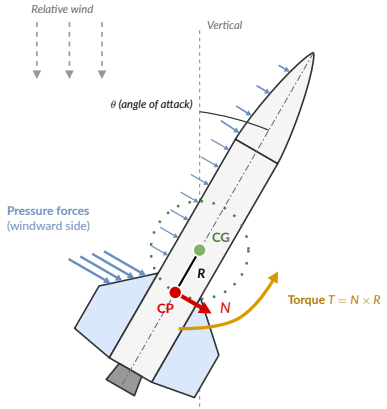
OpenRocket screenshot, last year's deck.

OpenRocket: design and flight simulation (free) openrocket.info

Values to check:

- Altitude **below 1000 ft**
- Stability **1.5 to 3.0** cal
- Ground hit velocity **below 10 m/s**
- Dispersion map (landing area)

Stability



Study Companion, ch. 3, Fig. "The restoring torque" (cropped).

CG must be ahead of CP. A gust tilts the rocket; the air force at the CP turns the nose back into the wind.

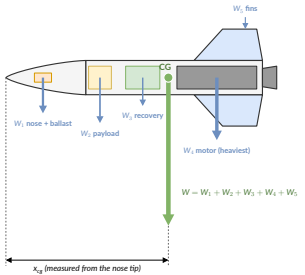
$$\text{margin} = \frac{X_{CP} - X_{CG}}{D} \quad \text{calibers}$$

- Rule of thumb: at least **1 caliber** (handbook)
- Our OpenRocket target: **1.5 to 3.0**
- Check it **with the motor installed**

+ CG forward: nose weight, longer rocket, lighter motor
+ CP aft: bigger fins, more fins, shorter rocket

Where the CG and the CP come from

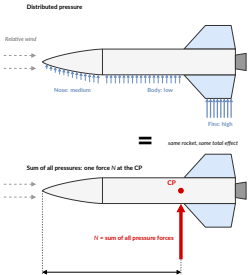
CG: centre of gravity



$$x_{cg} = \frac{W_1x_1 + W_2x_2 + W_3x_3 + W_4x_4 + W_5x_5}{W_1 + W_2 + W_3 + W_4 + W_5}$$

The balance point of all the weights. The motor is the heaviest part.

CP: centre of pressure

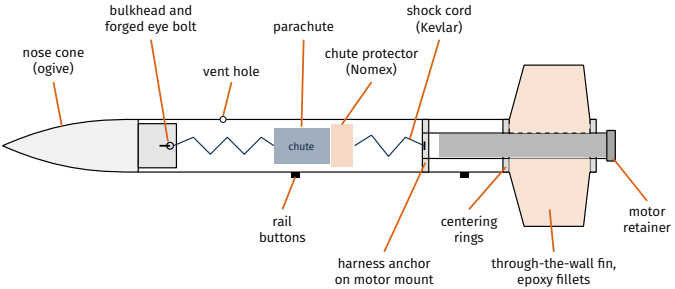


$$x_{cp} = \frac{N_1x_1 + N_2x_2 + \cdots + N_nx_n}{N_1 + N_2 + \cdots + N_n}$$

Where all the air forces add up. The fins pull it aft.

Study Companion, ch. 3, “Centre of gravity” and “Centre of pressure”.

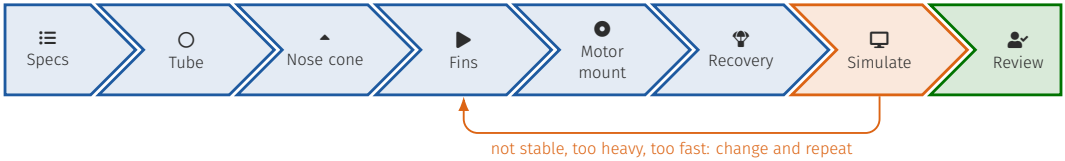
Anatomy of a certification rocket



D. R. Samii, *High-Power Rocketry Certification: A Study Companion*, ch. 5, "Anatomy of a certification rocket" (redrawn in deck colours).

Single deployment: the motor's ejection charge pushes the nose cone off and the parachute out.

Design workflow



The next slides follow this order. Requirements for L1: one H motor, single stage, single deployment; stable, recovered safely, flies again.

Start from the tube

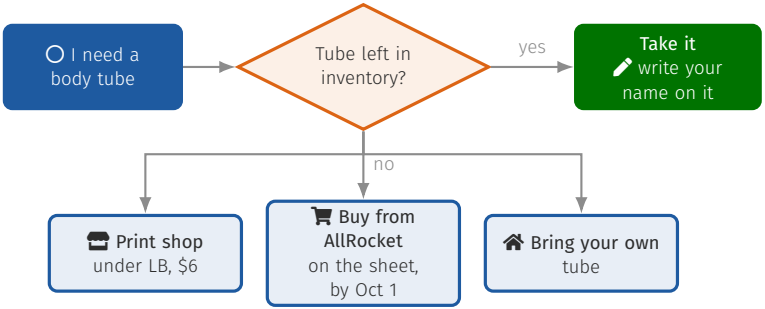


> The body tube is what you design around. You can make every other part; the tube is hard to make.

Measure your tube, then set:

- **Outer diameter** → nose cone base, fin root
- **Inner diameter** → nose cone shoulder, centering rings
- **Motor tube** (29, 38 or 54 mm) → centering ring hole
- **Length** → stability margin in OpenRocket

Tubes: 5 in inventory, first come, first served

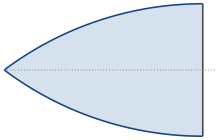


AllRocket
+ made for rocketry, matches kit parts
- shipping lead time

Print shop
+ on campus, see it before buying
- check diameter and wall strength

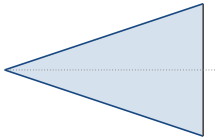
Your own
+ no wait
- unknown strength: have an L1+ member check it

Nose cone: shape



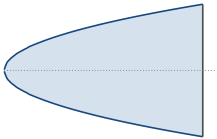
Tangent ogive

$$y = \sqrt{\rho^2 - (L-x)^2} + R - \rho$$



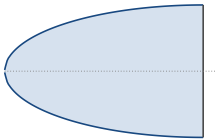
Conical

$$y = R\,x/L$$



Parabolic (power series, $n = \frac{1}{2}$)

$$y = R\,(x/L)^{1/2}$$



Elliptical

$$y = R\sqrt{1 - (x-L)^2/L^2}$$

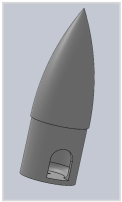
Study Companion, ch. 3, “Nose cone shapes” (redrawn in deck colours).

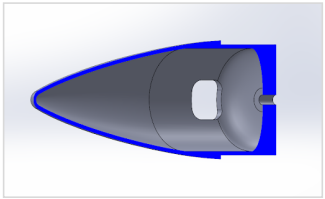
Default: tangent ogive. Low drag, smooth joint with the tube, easy to print.

\+ Conical: simplest to model
\- Conical: a small drag penalty at the shoulder
\+ Elliptical: tolerant of angle of attack
\- Elliptical: poor at higher speed

At our speeds, finish and fins matter more than the exact nose shape.

Nose cone: design details





- **Shoulder**: at least **one body diameter** long; stays in by its own weight unless shaken
- **Eye-bolt hole**: the nose pops off and pulls the parachute out
- **Base fillet**: at the shoulder, so the base does not snap
- **Hollow** is fine: room for tip weight if you need more stability

Nose cone in Onshape: fit it to your tube

1. Open the shared nose cone model
2. Make a copy in your own Onshape account
3. Open the **Variable table** (right panel)
4. Set the two **tube diameters** to your measured tube
5. Set **NoseConeLength**; ShoulderLength at least 1 tube diameter
6. Export **STL**; use the same sizes in OpenRocket

Onshape model

Variable	Default	
TubeOuterDiameter	0.102 m	your tube
TubeInnerDiameter	0.097 m	your tube
NoseConeLength	0.254 m	adjust
ShoulderLength	0.102 m	$\geq$ 1 diameter
Tickness (wall)	0.008 m	keep
NoseTipFillet	0.005 m	keep
ShoulderFillet	0.01 m	keep
WindowWidth	0.038 m	keep
WindowFillet	0.005 m	keep
HoleSize	0.008 m	keep

Defaults fit a 4 in (0.102 m) tube. Values in metres.

Printing the nose cone at the makerspace

1. Bring your **STL** to the **makerspace**
2. Open it in **Bambu Studio**
3. Filament: **PLA**
4. Strength tab: sparse infill density **100 %**
5. Check the size: the whole part, shoulder included, fits the limits
6. **Slice**, check the preview, then **print**

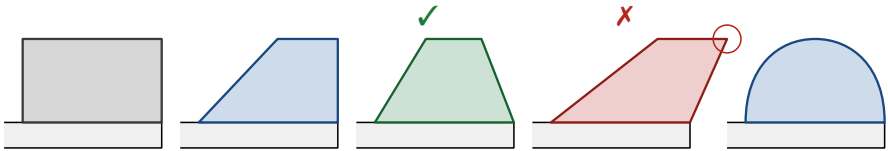
PLA, 100 %

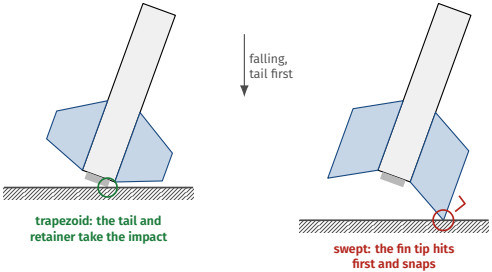
filament and infill: weak prints break

25 × 25 × 25 cm

maximum part size, shoulder included

Fins: shape

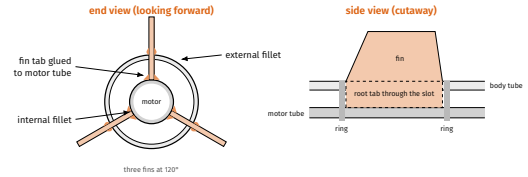




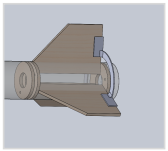
- **Trapezoid**: tips stay **ahead of the tail**
- Blunt tips, 3 or 4 identical fins
- Size the span for stability (see Stability)

- Swept past the tail: the tip hits the ground first and snaps

Fins: attachment



Study Companion, ch. 5, “Through-the-wall fins” (redrawn).

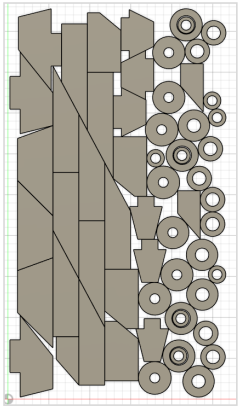




- **Fin tabs**: the fin goes through the tube wall to the motor tube
- **Jig**: keeps fins aligned while the epoxy cures
- **Fillets**: epoxy along each fin and tube joint

Draw the **tab** on your fin: it is laser cut with the fin.

Fins and rings: one shared plywood sheet



Last year's sheet layout.

1. Everyone **submits their fins and centering rings**
2. All parts are placed **together on one plywood sheet**
3. The sheet is **laser cut at concom**
4. We **split the cost**

+ cheaper than cutting alone
+ same wood, same quality

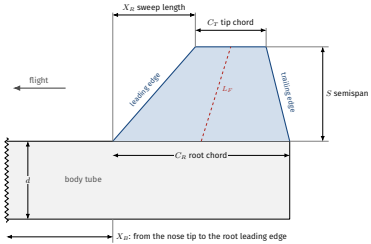
- one deadline for everyone
- late parts miss the sheet

Fins and rings: how to submit

1. Open the 🔗 Wood parts folder
2. Make a folder with **your name**
3. Put in a **SolidWorks part** (.SLDPRT) for each fin and ring; no CAD? a **dimensioned drawing**
4. Write **how many** of each in the file name

```
fin_x4.SLDPRT  centering_ring_x3.SLDPRT
```

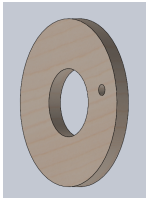
Wood parts folder



Study Companion, ch. 3, "Fin geometry" (redrawn).

Inside the rocket: motor mount and recovery

Motor mount



2 to 3 centering rings, 1 bulkhead with an eye-bolt hole.

Tight fit on the body tube and the motor tube.

Wood, fibreglass or carbon: **never 3D printed**.

Motor retainer on the aft end.

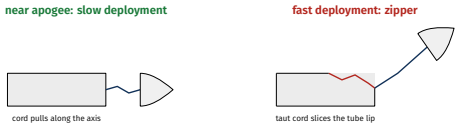
Recovery

Shock cord about **4 times** the rocket length.

Kevlar near the motor (heat).

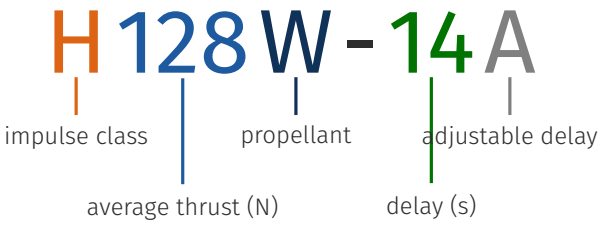
Protect the parachute from the ejection gas.

Vent hole below the nose cone.



Study Companion, ch. 5, “Zippering” (redrawn).

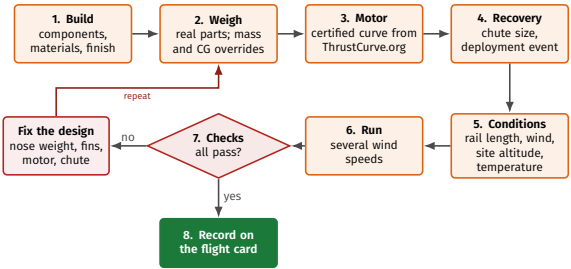
Motor naming



H = 160.01 to 320 N s total impulse: the **Level 1** class. Each letter doubles the one before.

Delay: seconds from **burnout** (not ignition) to the ejection charge.

Simulate before you buy



Study Companion, ch. 4, "The workflow in OpenRocket" (redrawn in deck colours).

- Enter the **real** masses as you build
- Pick the exact motor (ThrustCurve.org data)
- Run 0, 10, 20 and 30 km/h wind

Hard limits
thrust to weight at least **4:1**
mass below the motor's maximum liftoff weight

Upload your OpenRocket file

1. Name the file with **your name** `Firstname_Lastname.ork`
2. Upload it to the 🔗 OpenRocket Files folder
3. We check every file
4. If there is an issue, we let you know so you can fix it

Deadline
Thu, Oct 1

OpenRocket Files

Intro

Membership

Exam

Design with OpenRocket

Purchasing and manufacturing

Launch day

All purchases: the AllRocket sheet

DEADLINE
Thursday, October 1, 23:59

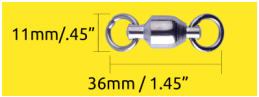
Every rocket purchase goes through this sheet. No row, no order.

1. One row per person: your **full name**
2. A **quantity** under each item you need
3. Your **wood part needs** (files in the Drive)
4. Check the **estimated total** for your row

AllRocket sheet

AllRocket parts: what they are for









Quick link

Screw-gate link. Joins the shock cord to the eye bolt, the parachute and the nose cone. Use **rated** links.

Swivel

Between the parachute lines and the shock cord. The rocket can spin without twisting the lines, so the canopy opens.

Rail buttons

Guide the rocket up the launch rail (1010 = 1 in rail). Two per rocket: one near the tail, one near the CG.

Motor

Powers the rocket: one **H** motor for L1. Its diameter (29, 38 or 54 mm) sets your motor tube.

Photos: last year’s deck.

Concom week: Monday, October 5 to Friday, October 9



Concom: where we build

Concordia Centre for Composites
EV building, 14th floor
All the tools you need are there.
concordia.ca/research/composites

Access: complete your **HWD** and **WHMIS** training first.

Schedule: **posted soon**.

Come with

- [ ] Your parts ready to assemble
- [ ] Nose cone printed
- [ ] Tube, motor tube, hardware
- [ ] OpenRocket file (CG, CP marked)

Everyone with L1 or higher will be there to help you build.

Safety in the lab



- Epoxy: gloves always, work under the fume hood

Intro

Membership

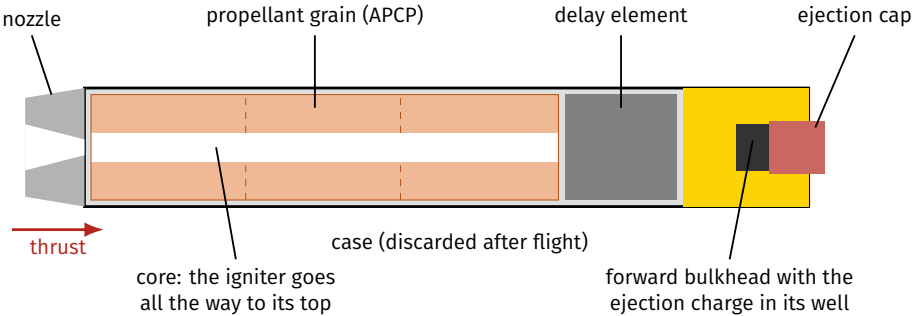
Exam

Design with OpenRocket

Purchasing and manufacturing

Launch day

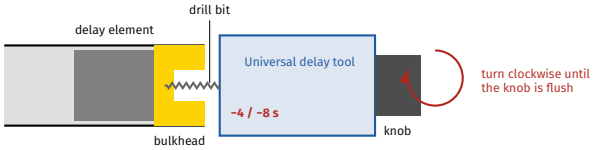
Inside the motor



Study Companion, ch. 7, "Inside a single-use (DMS) motor" (redrawn in deck colours).

It burns from the nozzle forward: **propellant** (thrust), then the **delay** (smoke, coasting), then the **ejection charge** fires forward and pushes the nose cone off.

Motor prep 1: set the delay



washer under the knob: remove 2 s less
never shorten below 6 s



Diagram: *Study Companion*, ch. 7. Photo: AeroTech DMS instructions.

- The printed delay is the **longest**
- Pick the delay from your **OpenRocket coast time**
- Tool side **−4** or **−8** s faces the bit; washer: 2 s less
- Turn clockwise until flush, shake out the shavings

Done **at the event**, with the tool. No flame nearby.

Motor prep 2: the ejection charge

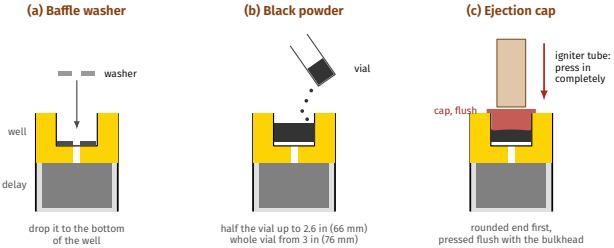




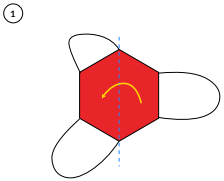


Diagram: *Study Companion*, ch. 7. Photos: AeroTech DMS instructions.

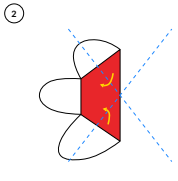
- Baffle washer to the bottom of the well
- Black powder: **half the vial** up to 2.6 in (66 mm), **whole vial** from 3 in (76 mm)
- Cap **rounded end first**, pressed flush with the igniter tube

Then the motor goes in with **positive retention**. Igniter only at the pad.

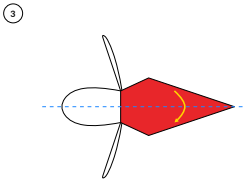
Packing the parachute: steps 1 to 6



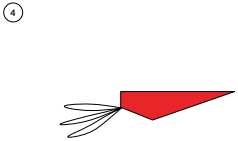
Fold the hexagon in half



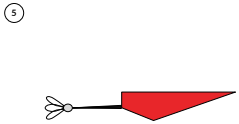
Fold the top and bottom in



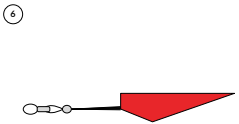
Fold the wedge in half lengthwise



A slim strip, a bit narrower than the tube



Stretch the shroud lines, tie the ends



Attach the **swivel**

Study Companion, ch. 6. Blue dashed: fold line; yellow arrow: fold direction.

Packing the parachute: steps 7 to 11

7



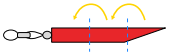
Lay the shroud lines on the canopy

8



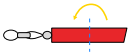
Fold across to trap the lines inside

9



Fold the right side over, twice

10



Fold once more

11

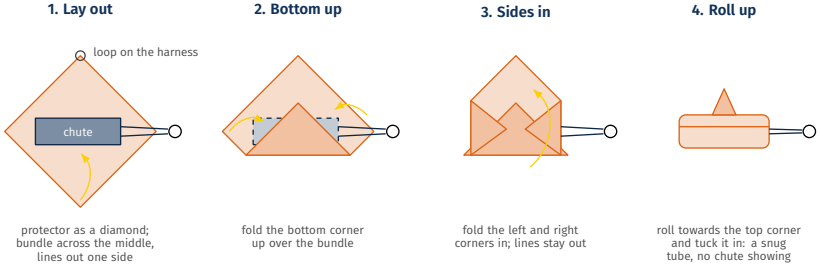


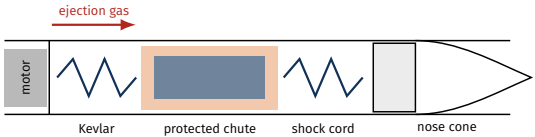
Finished: knot and swivel free

Study Companion, ch. 6.

Firm but **soft** bundle. It should slide out with a light pull.

Protect it and load it

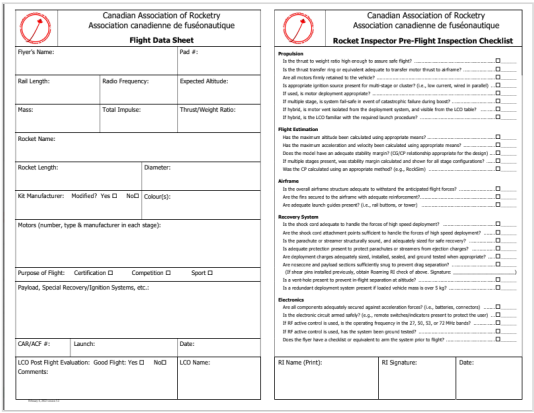




- Protector: **Nomex** or a square of **cotton jeans**
- From the motor end: Kevlar, protected chute, cord, nose cone
- Nothing tight: **slide test** at home

Study Companion, ch 6, "The burrito wrap" and "Loading order"

At the pad: inspection and paperwork



Canadian Association of Rocketry
Association canadienne de fuséonautique

Flight Data Sheet

Flyer's Name:		Pad #:
Rail Length:	Radio Frequency:	Expected Altitude:
Mass:	Total Impulse:	Thrust/Weight Ratio:
Rocket Name:		
Rocket Length:	Diameter:	
Kit Manufacturer: Modified? Yes ☐ No☐	Colour(s):	
Motors (number, type & manufacturer in each stage):		
Purpose of Flight: Certification ☐ Competition ☐ Sport ☐		
Payload, Special Recovery/Ignition Systems, etc.:		
CAR/ACF #:	Launch:	Date:
LCO Post Flight Evaluation: Good Flight: Yes ☐ No☐ Comments:		LCO Name:

Canadian Association of Rocketry
Association canadienne de fuséonautique

Rocket Inspector Pre-Flight Inspection Checklist

Propulsion
- Is the thrust to weight ratio high enough to assure safe flight? ☐
- Is the thrust transfer ring or equivalent adequate to transfer motor thrust to airframe? ☐
- Are all motors firmly retained to the vehicle? ☐
- Is appropriate ignition source present for multi-stage or cluster? (i.e., low current, wired in parallel) ☐
- If used, is motor deployment appropriate? ☐
- If multiple stage, is system fail-safe in event of catastrophic failure during boost? ☐
- If hybrid, is motor vent isolated from the deployment system, and visible from the LCO table? ☐
- If hybrid, is the LCO familiar with the required launch procedure? ☐

Flight Estimation
- Has the maximum altitude been calculated using appropriate means? ☐
- Has the maximum acceleration and velocity been calculated using appropriate means? ☐
- Does the model have an adequate stability margin? (CG/CP relationship appropriate for the design) ☐
- If multiple stages present, was stability margin calculated and shown for all stage configurations? ☐
- Was the CP calculated using an appropriate method? (e.g., RockSim) ☐

Airframe
- Is the overall airframe structure adequate to withstand the anticipated flight forces? ☐
- Are the fins secured to the airframe with adequate reinforcement? ☐
- Are adequate launch guides present? (i.e., rail buttons, or tower) ☐

Recovery System
- Is the shock cord adequate to handle the forces of high speed deployment? ☐
- Are the shock cord attachment points sufficient to handle the forces of high speed deployment? ☐
- Is the parachute or streamer structurally sound, and adequately sized for safe recovery? ☐
- Is adequate protector present to protect parachutes or streamers from ejection charges? ☐
- Are deployment charges adequately sized, installed, sealed, and ground tested when appropriate? ☐
- Are reasecone and payload sections sufficiently snug to prevent drag separation? ☐
- (If shear pins installed previously, obtain Roaming RI check of above. Signature: _____)
- Is a vent hole present to prevent in-flight separation at altitude? ☐
- Is a redundant deployment system present if loaded vehicle mass is over 5 kg? ☐

Electronics
- Are all components adequately secured against acceleration forces? (i.e., batteries, connectors) ☐
- Is the electronic circuit armed safely? (e.g., remote switches/indicators present to protect the user) ☐
- If RF active control is used, is the operating frequency in the 27, 50, 53, or 72 MHz bands? ☐
- If RF active control is used, has the system been ground tested? ☐
- Does the flyer have a checklist or equivalent to arm the system prior to flight? ☐

RI Name (Print):	RI Signature:	Date:

CAR/ACF Flight Data Sheet and Rocket Inspector checklist (last year's deck).

The Rocket Inspector will ask

- Where are your **CG** and **CP**?
- How did you check stability?
- What does your motor designation mean?

Bring, filled in

- Flight card (Flight Data Sheet)
- HPR Certification Form
- OpenRocket design details, printed

Total impulse and thrust: thrustcurve.org

Questions?

- Ask a team member with L1 or higher
- Updates will be posted in the team chat

