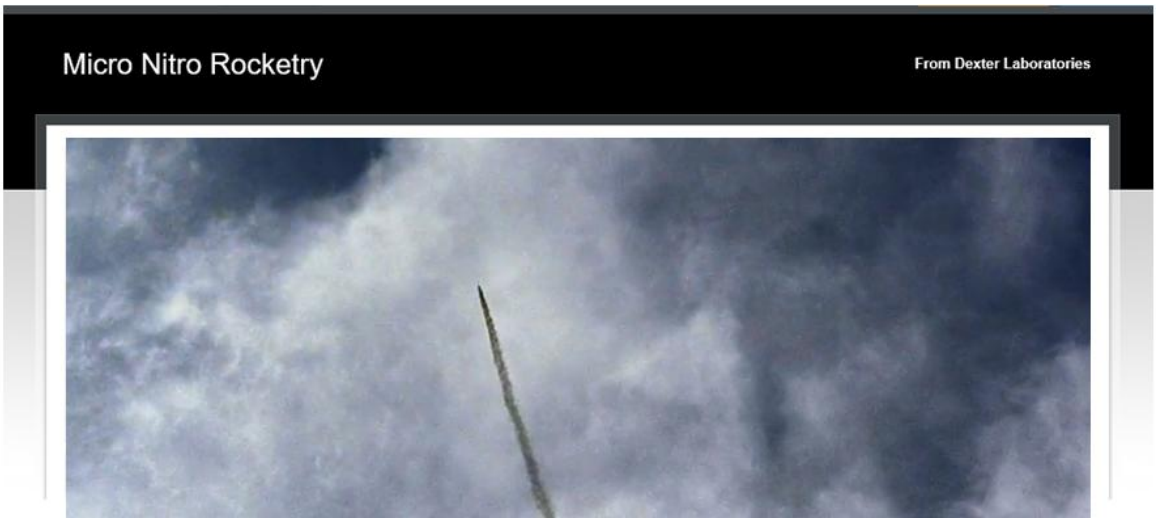


Micro Nitro Rocketry 2026 Digital Catalog

Welcome to Micro Nitro Rocketry, maker of small cartridge-based hybrid rocket motors. These motors are based on a design by Rene Caldera from the mid-1990s. I am "hand-dialed" machining these motors in very small batches (typically 4 motors per run to minimize tooling change-out time and material waste). In addition I am offering prototype rocket kits specifically for these motors along with some related products:

Publications
Precision machined motors.
Consumables like O-rings and burst disks.
Replacement parts Support equipment.
Specialized rocket kits.
Other accessories.

Micro and mini-hybrid motors use whip cream dispenser chargers and shopping bag paper for propellant. Micro and mini-hybrid motors are very safe, easy to operate and inexpensive to fly using rocket kits from us, modified Estes and Quest kits, and scratch-builds of your own design

The photo in the right column shows a Mayfly II airframe built by Matt Rolley of Alexandra Hills Australia flying on a Dexter Labs long case Micro-hybrid motor, Quick Whip 9 gram cartridge, 0.028" injector, burning 3D printed ABS fuel

Micro and mini-hybrid motors are very safe, easy to operate and inexpensive to fly using rocket kits from us, modified Estes and Quest kits, and scratch-builds of your own design.

These small experimental motors are direct descendants of those sold in kit form by Rene Caldera (see video in Extras).

Arguably the most elegant hobby rocket motor of its size ever designed.

For any questions you may e-mail me at:

nmrockets@yahoo.com

Leland (Lee) R. Dexter, Ph.D.
Owner, Micro Nitro Rocketry
TRA 8306 L2
NAR 90581 L2

PDF PUBLICATIONS:

Since 2011 I have been researching, manufacturing and flying these fascinating little motors. Over the years I have assembled three volumes comprised of notes to myself, instructions for my motor customers, useful tips for owners of any manufacturer's cartridge-based hybrid and some of my research results pertinent to flying rockets with these motors. Previously I offered these publications for sale in a series of three PDF manuals (over 300 pages). I am now making these manuals available free of charge for anyone who has an interest. Hopefully they will help you decide if you would like to try and enter the small cartridge-based hybrid motor arena.

Dexter Labs Quick Start Guide – 37 pages – current version 12/3/25

A concise introduction to flying these small hybrids. It includes an overview of the motor, a description of the motor parts along with the necessary consumable components and how to source them, assembly instructions and plans for a first flight airframe that does not need and altimeter or even a parachute!

Dexter Labs Micro and Mini-hybrid User's Manual - 198 pages - current version 1/16/26

This PDF covers the background development, motor types and features, assembly instructions, static testing, motor specifications, performance of various fuels, previous lessons learned, success and failure description and quantification, references and extensive resources. This is followed by over a dozen detailed how-to appendices.

Dexter Labs Micro and Mini-hybrid Rocket Construction Manual - 204 pages - current version 1/23/26

This PDF covers construction of airframes suitable for use with micro and mini-hybrid rocket motors. It is broken into three major sections; 1) details of specific airframe components, 2) examples of over a dozen commercial kits modifications and scratch-builds to fly with these motors, and 3) detailed instructions for two prototype kits I have designed specifically for these motors.

Dexter Labs Test Stand Paper - 40 pages - current version - 10/25/25

This PDF covers the construction of an electronic static test stand useful for micro and mini-hybrid rocket motors and also useful for commercial and experimental solid fueled motors as well. This test stand is capable of monitoring and recording both thrust and chamber pressure.

For the time being I am making these manuals available by direct e-mail request. To obtain these manuals please e-mail me at:

nmrockets@yahoo.com

and I will attach them to reply e-mails.

NEW! Also available by e-mail request:

MAKING A HIGH-POWER VERSION OF THESE CARTRIDGE-BASED HYBRIDS

From the early 1990s through the late 2000s the ATF pressure against the sport rocketry use of APCP propellants encouraged many high power rocketeers to turn toward hybrid technology to avoid stiff regulations on the shipping, storage and use of rocket propellants. AeroTech was a leader in those efforts on the commercial front. In 1995 they introduced "J" through "M" class versions of a hybrid motor that used pre-pressurized flight tanks and avoided complicated GSE at the launch pad (very similar in operation to the micro and mini-hybrid motors).

Unfortunately these superbly made motors were sold only a few years until 2001. In 2022 Patrick Carroll started working on a way to revive this motor using mostly off the shelf parts. I am providing persons interested in this approach with an outline of how to put together one of these motors based on Patrick's excellent work. Note that this is an advanced experimental motor project requiring level 2 or 3 certification to fly at Tripoli Rocketry Association sponsored research launches.

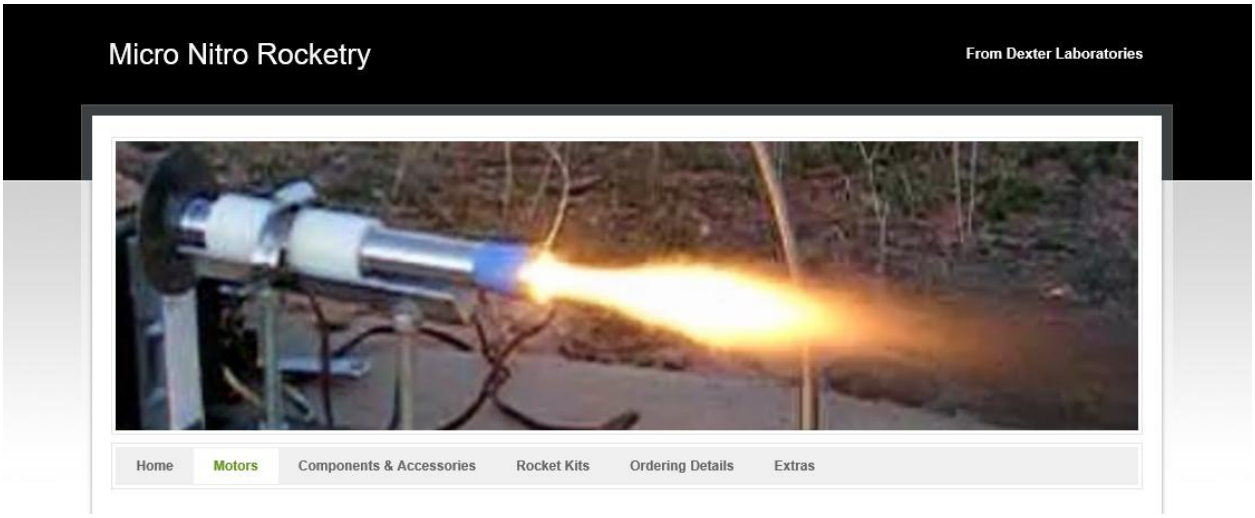
Dexter Labs Quick Guide to Making Patrick Carroll's Revival AeroTech Hybrid - 35 pages - current version 2/18/26

Dexter Labs Notes on Modifying a Pin Valve for Patrick Carroll's Revival AeroTech Hybrid - 21 pages - current version 7

Dexter Labs Notes on Making Fixed Jet Injector Plates for Patrick Carroll's Revival AeroTech Hybrid - 12 pages - current version 3

Dexter Labs Notes on the Madien Flight of a Revival AeroTech Hybrid - 13 pages

Please send an e-mail request to obtain these publications as well,



PRECISION MACHINED MOTORS:

Micro-hybrid 22 mm, 8-gram, 0.020" injector, motor - complete hardware $99
see www.micronitrorocketry.com for current availability
Rebuild kit (injector, nozzle, O-ring set) $30

Mini-hybrid 25 mm, 16-gram, 0.025" injector motor - complete hardware $125
see www.micronitrorocketry.com for current availability
Rebuild kit (injector, nozzle, O-ring set) $35

Mini-max 29 mm specialty bi-hybrid motor, 16-gram, 0.031" injector motor (beta-test) – complete hardware for the D12 version (E12 waiting on Estes improved motors). Level 2 Certification required for beta test program participation. $120
see www.micronitrorocketry.com for current availability

Mini bi-hybrid 25 mm prototype motor - complete hardware $145
Occasionally I manufacture one of these prototype specialty bi-hybrid motors for sale. It is distinguished from the traditional mini-hybrid by 1) a shorter case optimized to fit the modified C6-0 bi-hybrid grains, 2) a lightweight case included, 3) a specially machined reduced weight injector housing and 4) a second external snap ring groove ½" above the typical groove. All of these modifications allow this motor to be: 1) piston launched, 2) staged, 3) bi-hybrid powered or 4) all of these in one flight! Applying all four potential power boosts has allowed this motor to fly rockets to 2845' altitude. This motor is intended for experienced small hybrid users and, because bi-hybrids use BP inside a metal motor case, Tripoli level 2 certification, and preferably research experience, is required for purchase.
Rebuild kit (injector, nozzle, O-ring set) $35

Lightweight casing (33% lighter for the micro, 28% lighter for the mini and mini-max) add $12

A special note on lightweight casings…these motors are heavy for their power class for a number of reasons not the least of which is the steel N_2O cartridge etc. In an attempt to get the best flight performance out of these motors I offer this lightweight case option (typically 10% to 20% improved peak altitude). The tradeoff is a lack of robustness; everything must go right with lightweight versions of these motors and the tolerance for errors is very minimal. If you are just starting out with these motors I suggest purchasing an extra standard weight casing along with the full lightweight motor. Perform all your tests (static and flight) with the standard weight case and then fly your performance flights with the lightweight case!

Long casing (7" for the micro, 9" for the mini) add $10

Very limited testing suggests adding one inch to the case length may increase the total impulse by about 10 to 15%. For those of you willing to experiment with this, I offer a long case version. This version makes less efficient use of raw tubing so costs a bit extra.

Extra external snap-ring groove add $5

This groove is placed a half inch above the standard external snap-ring groove and is useful in the specialized cases of certain two-stage flights or piston launches. In both of these cases another body tube will be slipped over the rear end of the motor and the extra half inch of motor case below the second snap-ring allows for this. Note that there is a slight probability of increased case burn through compromise by adding this second groove.

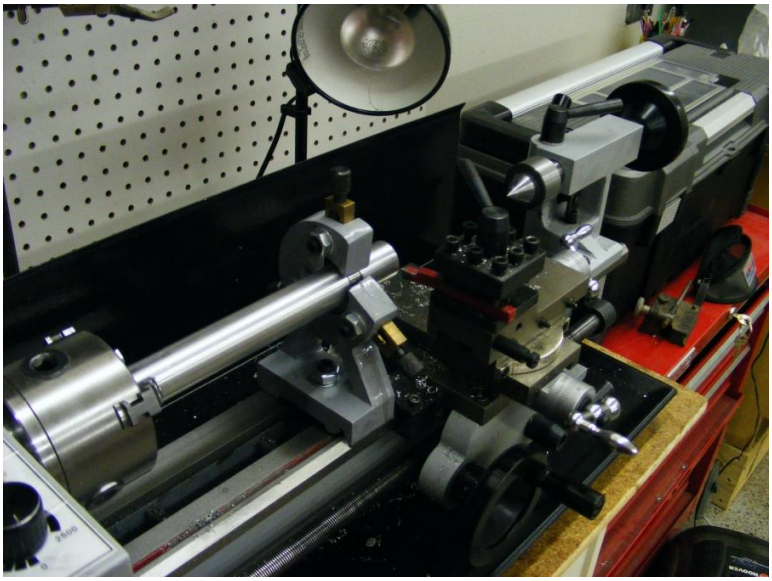
Extra thick injector housing floor no additional cost

Some nitrous cartridges are difficult to puncture (Quick Whip 9 gram cartridges for example). A thicker injector housing floor will help but will make ignition a bit more difficult. If you plan on routinely using such cartridges you can specify this extra thick floor with your order. However, if your standard floor injector housing fails because of this problem it is covered at no cost under warranty.

Dexter Labs Micro-hybrid to 24 mm motor adapter tube $3
Dexter Labs Mini-hybrid to 29 mm motor adapter tube $4

The photo below shows the Dexter Labs small hybrid family (left to right):

The original 8 gram 22 mm Rene Caldera Micro-hybrid (lightweight case version)
The 16 gram 25 mm Mini-hybrid (lightweight case version)
The 16 gram 25 mm Stretch Mini-hybrid (lightweight and long case version)
The 16 gram 29 mm Mini-max Bi-hybrid (lightweight case version)
The 16 gram 29 mm nitrous-boosted Turbo APCP solid motor (standard case version)



All motors are precision "hand"-machined from aluminum, brass, stainless steel and graphite. The motor is supplied with a copy of an extensive user's manual (also available as a stand-alone product) including background and history, assembly and launch instructions, performance data, resource lists and more.

Micro Nitro Rocketry

From Dexter Laboratories

Home | Motors | Components & Accessories | Rocket Kits | Ordering Details | Extras

COMPONENTS, CONSUMABLES, SUPPORT TOOLS & ACCESSORIES:

Part	Micro	Mini
Complete Motors & Rebuild Kits		
Std. Motor (complete)	$99.00	$125.00
Lightweight case option add	$12.00	$12.00
Long case option add	$10.00	$10.00
Rebuild kit	$30.00	$35.00
Individual Parts (available only to existing motor customers)		
Case (std. 6061-T6 drawn alum.)	$25.00	$30.00
Injector body (aluminum)	$38.00	$45.00
Piercer/injector (brass)	$25.00	$25.00
Standard Graphite Nozzle (each)	$15.00	$20.00
Standard Nozzles (lots of three)	$30.00	$45.00
Snap ring set of 3 (steel / zinc)	$3.00	$5.00
Forward closure (aluminum & SS)		$20.00
Forward closure (SS T-nut)	$5.00	
Chafing washer (aluminum or SS)	$2.00	$5.00
Charging screw 3/4" (SS)	$1.25	$1.25
Charging screw 1" (SS)	$1.50	$1.50
Fancy Stuff		
Isomolded Graphite Nozzle (each)	$25.00	$30.00
Snap ring set of 3 (SS)	$10.00	$12.00
Charging screw 3/4" (aluminum)	$6.00	$6.00
Charging screw 1" (aluminum)	$7.00	$7.00

Rocket Kits & Accessories

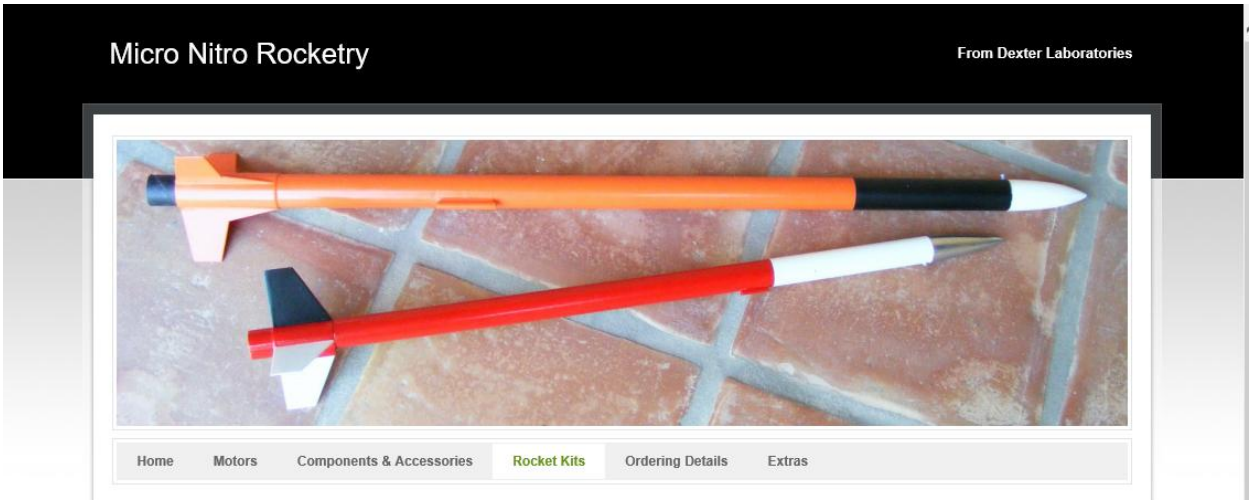
WhipperSnapper Prototype	**Out**	
Whippet Prototype		**Out**
Motor adapter tube (Micro-24mm)	**$3.00**	
Motor adapter tube (Mini-29mm)		**$4.00**

Consumables

Buna-N O-ring -009 (5 ct)	**$0.50**	**$0.50**
Buna-N O-ring -016 (10 ct)	**$1.00**	
Buna-N O-ring -018 (10 ct)		**$1.20**
Buna-N O-ring -115 (10 ct)		**$1.50**
Buna-N O-ring -117 (10 ct)		**$1.60**
Silicone O-ring -016 (ea)	**$0.55**	
Silicone O-ring -018 (ea)		**$0.60**
Silicone O-ring -115 (ea)		**$0.75**
Buna-N O-ring -117 (ea)		**$0.80**
Burst Disk (10 ct)	**$0.70**	**$0.70**

Ground Support

Complete Ground Support Kit	**$70.00**	**$70.00**
Burst disk punch, guide & die	**$40.00**	**$40.00**
Snap ring pliers	**$30.00**	**$30.00**
Pre-heater grain cutter	**$18.00**	**$18.00**
Paper grain rolling core	**$7.00**	**$7.00**
Hi Torque Allen wrench (3/16")	**$2.00**	**$2.00**
Users guide (free with motor)	**$8.00**	**$8.00**



MICRO AND MINI-HYBRID PROTOTYPE ROCKET KITS:

WHIPPET (top in the photo) Sorry, no longer available

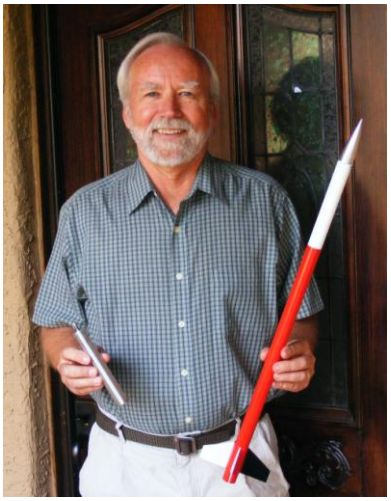
The Whippet kit is designed specifically for use with a Dexter Labs mini-hybrid motor. Lightweight altimeters such as the Perfectflite SLCF, Altus Metrum Easy Mini or Eggtimer Apogee are ideal companions for this kit. The finished rocket is 1.2" in diameter by 34.5" long and weighs 3.7 oz. Prototypes have flown to over 1000' (see videos in Extras).

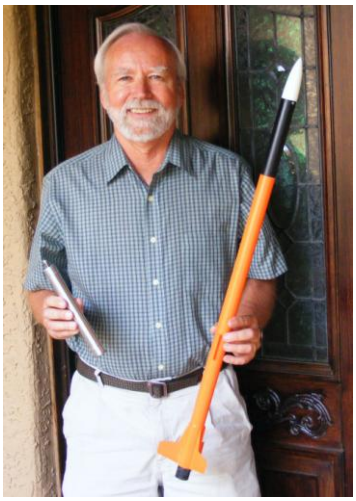
Request an info sheet and/or rocksim file from me by email nmrockets@yahoo.com

WHIPPERSNAPPER (bottom in photo) Sorry, no longer available

The WhipperSnapper kit is designed specifically for use with a Caldera-style micro-hybrid motor from any manufacturer. Lightweight altimeters such as the Altus Metrum Easy Mini or Eggtimer Apogee altimeters, or a magnetic apogee detector (MAD) are perfect companions for this kit. The finished rocket is 1" in diameter by 27" long and weighs 2.1 oz. Prototypes have flown to over 700' (see video in Extras).

Request an info sheet and/or rocksim file from me by email nmrockets@yahoo.com





FREE ROCKET AIRFRAME STUFF:

Priority Stealth Saucer Airfame

For many years Art Applewhite has been designing very creative and easy to build rocket powered craft for model through high-power motors. The Priority Stealth© is one of his creations and is absolutely brilliant! It is about as low cost as you can get, easy to assemble, easy to fly and requires no special deployment techniques or equipment, not even a parachute! Begin by navigating to Art's website,

www.artapplewhite.com

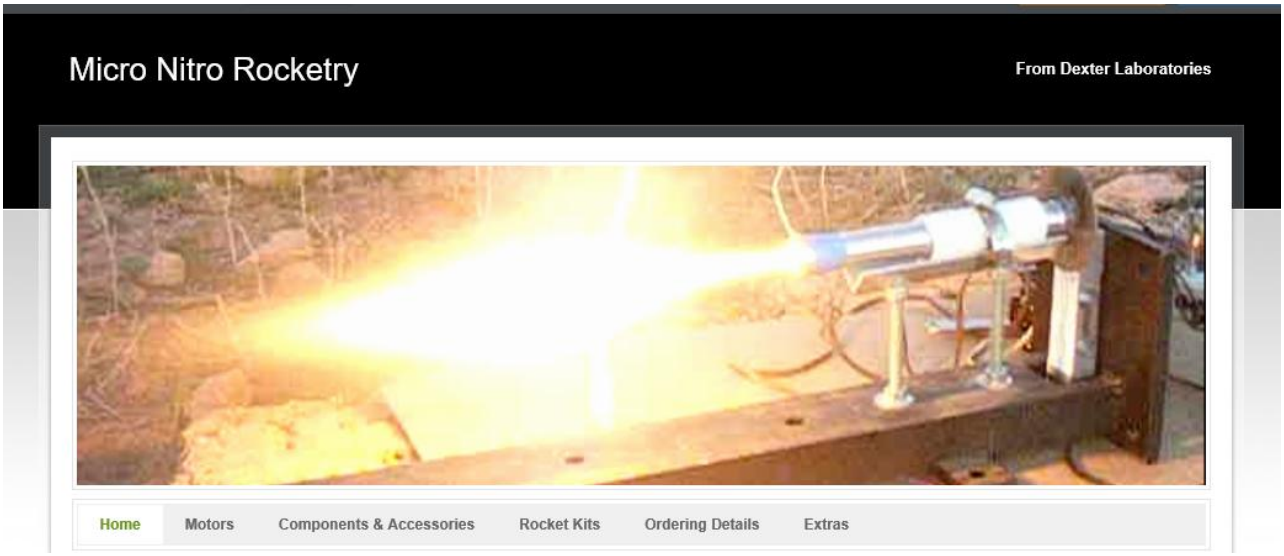
followed by a "conditions of use" page and then the "free stuff" page. Download the 29 mm Priority Stealth template and the associated instructions. Next, download and read the Dexter Labs Quick Start Guide available from a separate link to learn more about flying this craft.

Dexter Labs Superlight Scratch-Build Instructions Airfame

This is a set of instructions for a high performance rocket you can build yourself that will allow you to fly these relatively heavy small hybrid motors to respectable altitudes (1,000 to 3,000' or 305 to 915 m). This airframe is easily scalable and also modifiable for two-stage boosting, piston launching and dual deployment. Also, this rocket may be of interest fo my international motor customers where high shipping costs make sending kits overseas less attractive. Go to my website at,

www.micronitrorocketry.com

then navigate to the Rocket Kits page and scroll down to the button under FREE ROCKET AIRFRAME STUFF at the bottom of the page. It will help to have a copy of my Rocket Construction Manual along side of these instructions during the build.



Ordering Details:

Precision Machined Motors and Prototype Rocket Kits are Still Available on a Limited Basis

As the years have worn on my ability to spend hours doing custom machining has gradually diminished. While I am still offering items for sale to interested individuals, I am no longer focusing on manufacturing but rather researching and flying these fascinating motors. In addition, material costs have increased astronomically especially over the last couple of years. As a result my prices have increased but for equivalent motors made at commercial custom machine shops my rates are still comparably quite low. Producing motors in small batches, rather than by individual order, also helps keep the final price down. I apologize for the inconvenience of ordering delays!

I am currently producing a small number of motors, prototype rocket kits and some critical consumables for sale. I am making all motors in small batches based on my available time, material supply etc. and I may not have all motors in stock at any given time. For existing customers who have already purchased motors, replacement parts are available at any time. Please check my website (www.micronitrorocketry.com) for the current stock level of motors and kits.

The general ordering procedure is as follows:

1) **E-mail me at nmrockets@yahoo.com with your request or any further questions you may have. Unfortunately I am limiting sales to stock on hand and I am not able to maintain a back order list.**

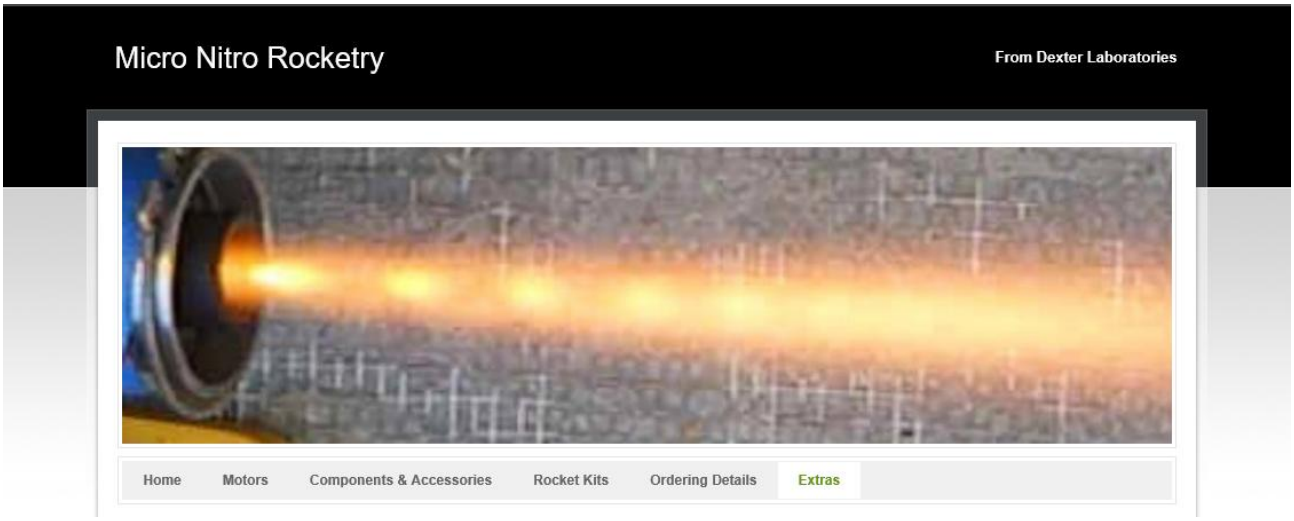
2) **I will reply with answers and a quote including shipping along with a blank order, liability waiver and contract form. I will also send more detailed odereing and shipping information that is especially useful for my international customers.**

3) **Complete the order, waiver and contract form, sign it and return it to me.**

4) **I will fill your order (typically within a week) and send you a PayPal invoice**

5) **Once payment has been received I will ship your order (I am best prepared to ship USPS priority mail which will keep your handling costs as low as possible).**

For any questions e-mail me at:
nmrockets@yahoo.com



EXTRAS:

Table of Contents (to see the actual video links, scroll down):

Christian Faix (DU) static firings of a number of 3D printed grains with star-patterned ports (5/15/21).Matt Rolley (AU) Semi-static test firing of a micro-hybrid burning paper with a 0.031" injector (3/8/23).Matt Rolley (AU) Semi-static test firing of a micro-hybrid burning Tasmanian Oak (3/8/23).
Matt Rolley (AU) Slo-mo liftoff of a micro-hybrid powered Mayfly rocket burning ABS (6/7/23).
Dexter Labs (US) Igniter/pre-heater grain test stand (6/14/23).
Matt Rolley (AU) Long-case micro-hybrid powered Mayfly II on a ABS 12 point spiral star grain (8/18/23).
Dexter Labs (US) Tour of the Red Lake launch setup and pibal release (10/15/23).
Dexter Labs (US) Flight of a Quest Icarus on a long case mini-hybrid burning ABS fuel (10/15/23).
Dexter Labs (US) Flight of a Dexter Labs Superlight on a Mini-Max Bi-hybrid to 1150' (10/15/23).
Dexter Labs (US) Flight of a Mad Cow Discovery on a Mini-Max TURBO Bi-hybrid to 902' (10/15/23).
Dexter Labs (US) A scratch built Aerobee Hi flies to 1,560' on a 3x2 micro bi-hybrid (10/15/23).
Dexter Labs (US) Piston assist, 3x2 boosted mini bi-hybrid flight to 2,845' (confirmed) on a D. L. Superlight dual deploy airframe; by far, my best yet (10/15/23).
Mini-hybrid 3D printed ABS grain static test (5/12/24).
Levi Willey's (US) static test of a Dexter Labs micro-hybrid burning a 3D printed PTEG star grain (4/5/25).
Crawford Karachale's (US) static test of a Dexter Labs mini-hybrid burning 3D printed ABS finocyl grain.

The actual video links and descriptions follow:

Rene Caldera's video showing his early micro-hybrid development work (ca. 2000) (may be blocked by Warner Music Group):

http://www.youtube.com/watch?v=DOnxS07HqVQ

Rene Caldera operated a website from the late 1990s through the early 2000s. Here he sold kits of material along with instructions for machining your own micro-hybrid. On that website he had also posted videos of his first micro-hybrid flights. As a tribute to Rene's inventiveness creating these small hybrids I am re-posting his three original flight videos. Along with the video I have also posted the flight report in Rene's own words. Read the video "Description" to view the report.

Flight number one (3/26/00):
https://www.youtube.com/watch?v=QIM_4c_OViq

Flight number two (4/23/00):
https://www.youtube.com/watch?v=kPC7bE0dmyQ

Flight number three(2/11/01):
https://www.youtube.com/watch?v=SyZexSpavi0

Gary Scroggs' 16 gram mini-hybrid motor in a static test using his custom polyester resin / iron oxide cast fuel grain. Look for his thrust curve data toward the end of the clip (10/31/09):

http://www.youtube.com/watch?v=KBcNJBPMeJ0

Gary Scroggs' 8 gram micro-hybrid motor in a static test using his custom polyester resin / iron oxide cast fuel grain. Look for his thrust curve data toward the end of the clip (11/1/09):

http://www.youtube.com/watch?v=2flbX1lxdzI

Jim Hefkey's static tests with "bi-hybrid" gains. Here a live Estes C6-0 motor is used as a fuel grain for a micro-hybrid. The Estes motor burns as a "booster" then ignites the hybrid which in turn burns the spent cardboard casing (12/23/11):

http://www.youtube.com/watch?v=UlVcuVLaPFU&feature=youtu.be

One of Jim Hefkey's bi-hybrid flight tests. Notice the "staging" is successful but the delay between the Estes burnout and the hybrid ignition is long and causes trajectory problems:

http://youtu.be/1dkYbcrBUrY

A Whippet rocket reaches 1,036 feet altitude powered by a Dexter Labs mini-hybrid motor using a 16 gram charger and bag paper fuel grain. This represents a typical mini-hybrid flight (3/29/12):

https://youtu.be/GykKE0qaj4E

A Dexter Labs WhipperSnapper rocket flying on a micro-hybrid motor using an 8 gram charger and bag paper fuel grain reaches 650'. This is a fairly typical flight for this rocket and motor combination (3/29/12):

http://www.youtube.com/watch?v=xcEbeB8-cPw

A modified Quest Bright Hawk rocket reaches 1,395 feet altitude powered by a Dexter Labs mini-hybrid motor using a 16 gram charger and a fuel grain cast from HTPB/powdered aluminum (4/12/13):

http://www.youtube.com/watch?v=dBWC1MWS_Pg

A Dexter Labs Whippet rocket lifts off powered by a mini-hybrid motor using a 16 gram charger and an HTPB / aluminum / lampblack fuel grain (5/15/13):

http://youtu.be/6F_Yia0X1-U

This is a static firing of "test article A" which is a mock-up of a three-burn by two-stage "bi-hybrid" rocket. The booster is a standard Estes D12-0 motor. At the end of its burn the D motor lights a modified Estes C6-0 motor loaded inside a Dexter Labs micro-hybrid motor. At the end of its burn the C motor lights the hybrid which then burns the spent Estes paper case as fuel. See the publications available on this site for more details (3/5/14):

http://youtu.be/FTpnCV3teiQ

A Dexter Labs mini-hybrid burning the spent case of an Estes C class motor. This is the burn that would occur as the third burn of a 3 burn by 2 stage rocket configuration (3/25/14):

http://youtu.be/RlWqTqlOm00

Take your Dramamine before viewing! Jesse Phillips provided this interesting on-board video taken from his Priority Stealth flown on a Dexter Labs micro-hybrid with a poly-phenol fuel grain. The Priority Stealth is a triangular saucer-type craft designed by Art Applewhite that is built from a cut-up cardboard box (see www.artapplewhite.com). The Priority Stealth spins on ascent, flips over at apogee and auto-rotates while descending. It is recommended as a test vehicle for these small hybrids since the high drag keeps apogee low and the auto-rotated descent requires neither altimeter nor parachute. Try "pause-stepping" through the video to see the details of the flight including some surrounding buildings caught at apogee. Notice the serrated edge of the saucer skirt remains visible in the lower portion of the frame (3/29/14):

http://youtu.be/PlBN3Z2KZgU

Jesse Phillips on-board video of a Dexter Labs micro-hybrid powered Snoodle rocket. These types of rockets are made from foam pool noodle toys similar to those developed by Dick Stafford and others. This is another way to fly these small hybrid motors without the need for a deployment mechanism (4/15/14):

http://youtu.be/XYiqOmjQZBs

Successful flight of a 3 burn by 2 stage Dexter Labs "bi-hybrid" micro-hybrid. In this flight a modified WhipperSnapper rocket is boosted with an Estes D12-0 motor. At burnout the booster ignites a modified Estes C6-0 motor grain contained within the combustion chamber of the micro-hybrid by direct staging. The C6-0 fuel burns supplying "cruising thrust" through the micro-hybrid's graphite nozzle. When the C6-0 grain burns out, the pre-heater grain is ignited, again by direct staging. The pre-heater grain starts the micro-hybrid which burns the paper case of the now-spent Estes motor as fuel. In all there are three separate burns contained in two physical stages. This flight was textbook with all burns completed successfully and with a vertical trajectory under calm conditions (peak altitude estimated at 1,500 feet). For more details see the User's Guide and Rocket Construction Manual (4/8/14):

http://youtu.be/06pz_Shckn4

Another very nice 3 burn by 2 stage flight of a Dexter Labs boosted WhipperSnapper rocket powered by a micro-hybrid motor. The boost is provided by an Estes D12-0 solid fuel motor and the sustainer is powered by a modified Estes C6-0 grain. The Estes motor has had its nozzle cut off and its diameter increased to fit snugly inside the Dexter Labs Micro-hybrid motor combustion chamber. This means that the hybrid burns once with the solid grain and once again with the nitrous oxidizer. The Estes grain is ignited via "direct staging" from the D-12 booster motor. At the end of its burn, the C6 motor ignites the hybrid pre-heater grain which melts the burst disc and starts the hybrid. The hybrid then burns the paper tube of the spent Estes C6-0 motor. The flashes seen late in the clip are from "flash panels" of automotive chrome trim tape wrapped around the body tube and also applied to the fins (10-27-15):

https://youtu.be/ZZFlqwn3R6A

A Dexter Labs mini-hybrid burning an HTPB - aluminum - lampblack grain on a static test stand. You can see the 16 pound test stand actually jump a bit at peak thrust. The average thrust is around 11 N over a 2.5 second burn and peak trust showed 68 N on the test stand but the motor was not tight against the thrust ring and thus hammered the load cell a bit. Peak thrust was actually more like 40 N. Overall impulse is 27.2 N s (3/17/16):

https://youtu.be/LFR5l6R9Qww

A Dexter Labs mini-hybrid motor burning a grain made from XX paper phenolic tube. This fuel has rather interesting burn characteristics. The burn starts quickly as is typical for these small hybrid motors and peak thrust is reached smoothly with no hard start or ragged burn like for HTPB-based grains. Peak thrust is 31 N at 0.05 seconds into the burn. The depletion limb of the burn is very smooth and remarkably long, lasting 9.5 seconds with no chuffing before final flameout! Overall impulse is 24 N s (3/17/16):

https://youtu.be/HL6jZUqCrjI

A Dexter Labs Whippet rocket flying on a mini-hybrid motor powered by a paper phenolic grain reaching 700'. Since phenolic seems to burn long and slow I increased the injector orifice diameter from 0.025" to 0.028". A faster burn and greater peak thrust is the result (4/16/16):

https://youtu.be/AH25H7vrl34

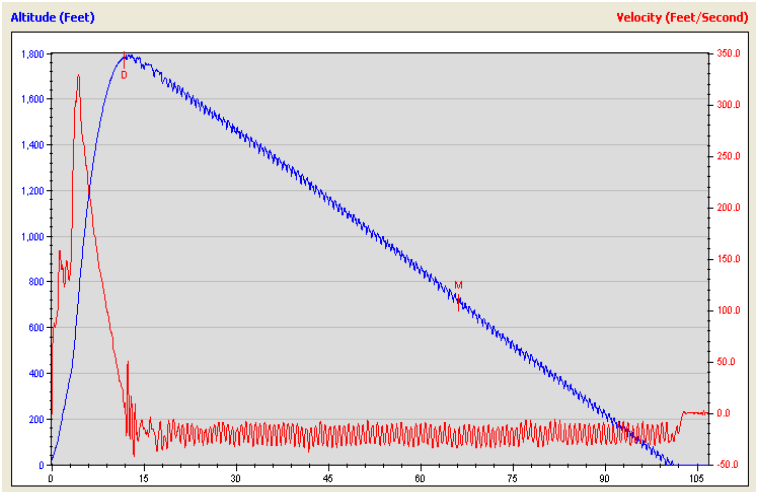
This video shows the full flight (takeoff through recovery) of a lightweight version of a Dexter Labs micro-hybrid motor burning a poplar wood grain. This motor is flying in a modified Estes Air Walker airframe which reaches an altitude of 1,042 feet, my highest flying single stage micro-hybrid to date (flown on 12/12/17):

https://youtu.be/s0SiTVW054Y

A nice dusk flight of a Dexter Labs 3" Boink rocket (pool noodle airframe) flying on a mini-hybrid motor burning a grain made from compressed artificial wax fireplace log material (10/24/18):

https://youtu.be/I5VAqoy0Rgo

This is an updated and extended video to a brief one I posted showing this launch. Since it represents my first fully successful mini bi-hybrid flight and remains one of my best flights for this motor I have added the pre-flight "pibal" release, the complete flight from launch to touchdown and a clip of the recovery. "Traditional" bi-hybrid launches for the mini-hybrid motor are difficult to pull off because the launch weight is very heavy for the C6-0 motor to push from a dead start even with the recommended modifications presented in my manuals. Adding a D12-0 powered booster changes the whole picture. The D12 gets the entire system moving to 150 fps. While providing no additional acceleration, the C6 (in reality around a C9 after the drilling mods) keeps the velocity fairly constant and when the E mini-hybrid kicks in burning the case of the C motor things speed up again to 330 fps. This modified Rookie with its booster reached 1,789 feet in a 12 second ascent (see the altimeter data plotted below):



https://www.youtube.com/watch?v=6MFsdthIfTQ

A Dexter Labs 29mm Mini-max bi-hybrid motor flying in a 3" Boink rocket (pool noodle airframe). The Mini-max is burning an Estes D12-0 motor. First the Estes burns its own black powder propellant then at the end of its burn the Estes starts the 16 gram mini-hybrid which burns the cardboard of the spent case (4/15/19):

https://youtu.be/hBDuyMwHAxY

A Dexter Labs 29mm Mini-max bi-hybrid motor flying in a 3" Boink rocket CATOs within its first 5 feet of flight. The Estes E12-0 motor used as the base grain was only slightly modified. It appears that the hybrid started early while the black powder was still burning but the root cause of the CATO is still unknown and is under study. I have come to learn that Estes E12 motors suffer high CATO rates! Until Estes resolves the problem (they are aware of the issue) I recommend using only the D12 version of the Mini-max motor. Notice that the fifty foot launch distance that I use for standard micro and mini-hybrids is not safe enough for these larger mini-max motors! (4/25/19):

https://youtu.be/n39IBCwWpOU

This is a flight of a Dexter Labs 3F&NC superlight scratch-build airframe powered by a mini bi-hybrid motor and boosted by a D12-0 grain contained in a modified Estes Mongoose booster. This all produces a 3 burn by 2 stage flight with a total launch weight of 272 grams, 100 grams lighter than the two-stage Rookie flight shown above.

This rocket was never recovered but based on comparisons of flight events from the Rookie flown to a known 1,789' it is conservatively estimated that this 3F&NC flight reached over 2,100'. My best performance to date:

https://youtu.be/aiPEtlCipQw

This is a static test firing of Gordon Strodel's (US) micro-hybrid burning an acrylic grain. The burn is classic for an acrylic grain with quick positive ignition, bright flame, and clean, smooth burn with no chuffing:

https://youtu.be/lFITTI38kIA

This is another view of Gordon's micro-hybrid burning an acrylic grain as seen in the previous clip. This time the video is slowed down and has very sensitive audio so you can hear interesting details of the burn:

https://youtu.be/FvlRNF8j7Sc

This is a static test of a mini-hybrid burning a phenolic grain that turned out completely unexpected. I have had long burns with phenolic before and that is one of the hallmarks of the material as a fuel but this burn is way longer than anything else I have ever experienced. Granted, it never produces over 1 newton of thrust but it burns for 55 seconds using only 16 grams of nitrous! Upon disassembly, the burst disk had only a pin hole but the pre-heater did ignite the main grain and the burn proceeds at a low level for almost a minute holding flame the whole time. To me, this emphasizes the variability possible with different burst disk melt characteristics and also the possibility of throttling this fuel type!

https://youtu.be/HQfEvYP18ng

Gordon Strodel's flight of a Prime Stealth saucer (Millennial's version of Art Applewhite's Priority Stealth) made from an Amazon box and powered by a micro-hybrid burning an acrylic grain. A very nice flight!

https://youtu.be/N_EqXeNXf_E

A slow motion video of the liftoff of Gordon Strodel's Prime Stealth flight powered by a micro-hybrid burning an acrylic grain. The sound effects are very interesting and "big rocket" like!!

https://youtu.be/lNEBvxhgVxo

A wild ride onboard a Dexter Labs Whippet mini-hybrid powered rocket burning poplar wood for fuel. The burn lasts 5 seconds and the rocket reaches just under 1,200 feet. The video is taken with a Fuvision mini camera simply aimed out a side port in the payload bay. Hence the video is upside-down for the descent and I have rotated the second part in editing so everything appears heads-up. I think the whistling sound is nitrous still venting at the end of the burn (but it could be air flow across the video port) and the whistle transitions into a gurgling sound as the last traces of nitrous are vented. The wire-like object flashing across some of the frames is the spent deployment charge. Despite all the yelping sounds, no puppies were harmed during the creation of this video.

https://youtu.be/5R_gL_5wyfI

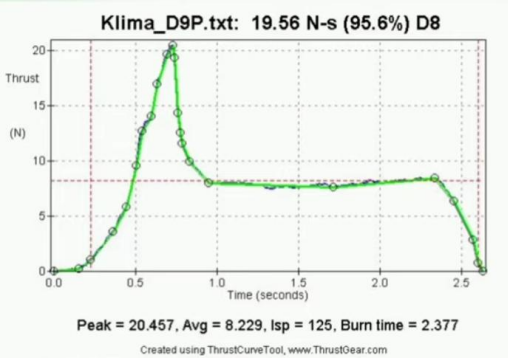
This is unedited video from the ascending portion of the flight of a modified Estes Firestorm and Booster 60 two stage airframe. This configuration is relatively low flying due to drag from the camera mirror pods extending beyond the 1.6 inch diameter body tube along with the additional mass of the video camera and bay.

Booster ignition starts at 5 seconds into the video. About 1.5 seconds later the over-drilled D12-0 booster burns out and separates. Flames can be seen still issuing from the top of the booster airframe as it falls away. Virtually simultaneously the mini-hybrid comes to life by direct staging from the D12-0 and the C6-0 (actually a C9 or 10 after the modifications) black powder grain burns for another 1.5 seconds as indicated by the spiraling smoke trail following the upper stage as it develops a small wobble ("cone-ing") after separation. A few sparks are all that indicates the end of the C grain burn which has been spiked with a bit of pyrogen painted in the top of the case to carry the flame across the "gap" to the pre-heater grain. The pre-heater grain then burns for about a half second with no visible indication in the exhaust. A brief puff of smoke follows indicating ignition of the nitrous/paper third burn that lasts for about three more seconds. After a brief coast the deployment charge is detonated by the Altus Metrum Easy Mini altimeter at apogee and the parachute is seen being ejected.

The video is obtained through a port in the side of the altimeter/camera bay and a 50 degree mirror affixed to an external pod adjacent to the port. You will notice that a "halo" of horizontal scenery surrounds the vertical view due to the camera seeing around the edges of the mirror pod. Video editing is needed to cut that away.

https://youtu.be/2Utp7LFxaxY

A nice set of test stand burn videos from Christian Faix in Germany for a couple of types of fuel grains I do not cover in my manual (ABS and HDPE) and the grains are 3D printed with star port patterns! Also he includes a Klima D9 black powder burn for reference (shown below left) which is nice since the Estes D and E motors are most often shown in the US for comparison. Note that his test stand is configured in a vertical thrust-down orientation which often leads to mostly gaseous N_2O being burned producing long-tailed down-curving thrust curves (shown below right).



https://youtu.be/bW5PjGSWeFM

Matt Rolley, one of my Australian motor customers, firing his micro-hybrid in a semi-static test where he uses his standard launch pad and a rocket as the test stand. By securing the pad against lifting and by capping the rail a few inches above the rocket he can observe and record the ability of the motor to lift the rocket, the speed and force with which the rocket lifts off, the duration of the lifting thrust, the full duration of the burn and the quality of the burn. All of this can be determined by time-stepping through frames of the resulting video! In this particular test Matt is using a standard paper grain but with an oversized injector (0.031"). Notice the lift is very strong and the burn is quite short (1.5 seconds) as to be expected from the oversized injector.

https://youtu.be/tedMOO7bDsk

Another Matt Rolley semi-static test. In this particular test Matt is using a wooden grain made from Tasmanian Oak (actually a type of eucalyptus) along with a standard sized injector for the micro (0.020"). The ignition is nice and quick for a small hybrid, the burn is vigorous with good lift (even causing the nose section to be forced off due to momentum) along with a nice shower of hot looking sparks that linger like welding sparks. The overall burn is 4 seconds long. I love that Tasmanian Oak for rocket fuel ☺

https://youtu.be/vzKEmdS9GGw

Slo-mo of Matt Rolley's Mayfly rocket lifting off on a Dexter Labs micro-hybrid motor burning a 3D printed ABS grain with a spiraled star port. Great flight Matt!!

https://youtu.be/SHpz-OX_7_E

Igniter to pre-heater grain transition problems are the most common reasons these small hybrids fail to launch. Rather than waiting until you are at the range to evaluate the effectiveness of your igniter and pre-heater grain combo, I have come up with this simple test arrangement that fairly closely simulates the igniter/pre-heater contact during an actual launch. The stand consists of a base (block of wood) and vertical support (coat hanger wire, skewer etc.) to which the igniter is taped vertically. A short piece of 1/2" ID brass tube is used to hold the pre-heater grain at the tube top end. Place the tube/pre-heater grain over the igniter arrangement and fire when ready. If your igniters work consistently you will have far better luck on the range!

https://youtu.be/rZCsqP1oIsE

Matt Rolley flying his Mayfly II rocket on a Dexter Labs long case micro-hybrid motor. This flight is fueled with one of Matt's great 3D printed ABS grains, a 12 point finocyl with a 180 degree spiral twist down the length of the port. The N2O cartridge is a 9 gram Quick Whip injected through a 0.025" orifice jet. This burn is quick with without the long regressive tail typical of these small hybrids. The flame is bright flame, the smoke is dark and the sound is fairly throaty for a tiny hybrid.

https://www.youtube.com/shorts/AYnrJOU814o?feature=share

Tour of the Red Lake launch setup for my higher-flying small hybrids and a pibal balloon release. For those of you who are interested in my record attempts with micro and mini-hybrid powered rockets, this is a tour of my launch setup at Red Lake Playa Arizona. This setup is typical of those that I have used there for over a dozen years. This particular launch series ran from Wednesday October 12, through Sunday October 15, 2023. Also included at the end of the tour is the pibal balloon release to check for wind conditions aloft that Sunday morning. This launch trip produced four new personal best records including a never before flown mini-max Turbo bi-hybrid in a Mad Cow Discovery airframe to 902' (I suspect higher flights from this motor / rocket combo will be fairly easy to attain), a D version mini max bi-hybrid in a D. L. Superlight airframe to 1,150', a 3x2 micro-hybrid flight of my Aerobee Hi to 1,560' and a piston enhanced 3x2 dual deploy flight to 2,845' along with some other beautiful fights. Videos from all those flights are posted on this channel. A very good series of flying days this year!

https://youtu.be/AwZ8hwpIbRM

Quest Icarus flight on a mini-hybrid burning an ABS grain. This video shows the flight of a Quest Icarus rocket powered by a Dexter Labs Mini-hybrid burning an ABS 3D printed 12-point finocyl (star) grain designed and drafted by Matt Rolley of Alexandria Hills, Australia. This kit is particularly significant in the small cartridge-based hybrid world because Rene Caldera choose it as the rocket of choice to test fly his micro-hybrid motor design back around 2000 or so and this is a tribute flight to him! Rene used a magnetic attitude detector (MAD) for his deployments, I am using an Eggtimer "Apogee" altimeter for deployment here. The flight is very nice with thick dark smoke not seen in many hybrid fuels. The burn sounds powerful for an E class motor and the flight reaches 1156'. Recovery was textbook!

https://youtu.be/4KuyRuSliel

This is the flight of a Dexter Labs Super Light 29 mm version airframe powered by a Mini-Max (MMX) D class Bi-hybrid. In this motor a pretty much stock Estes D12-0 motor is used at the two burn propellant grain in a 29 mm mini-hybrid using 16 gram nitrous chargers. The only modifications to the Estes D motor is to over-drill the pintel-pressed core by 3/8" and paint some pyrogen in the empty paper case above the BP grain. This pyrogen facilitates the ignition of the hybrid. So the flight goes like this: 1) an Estes igniter starts the D12-0 motor which burns with more thrust than a standard Estes D because of the over-drilling but burns for a shorter duration. This improves boost power of the black powder burn. The end of the BP burn ignites the pyrogen and then the pre-heater grain of the hybrid and, ultimately, the hybrid kicks in burning the paper case of the Estes grain. This is a fairly representative flight for one of my MMX 29 mm bi-hybrids and the rocket reached 1,150 ft (350 m) after downloading data from the Featherweight Raven 3 altimeter.

https://youtu.be/UIDhA8gAeCs

First Mini-Max TURBO Bi-hybrid flight! Back in the mid-1990's, in light of BATF pressure on APCP propellant for sport use, AeroTech developed a line of beautifully crafted hybrid motors in the J to M power class. One of the several unique aspects of these AeroTech motors was the availability of certified grains that included various amounts of White Lightning propellant incorporated in a hybrid fuel grain. In effect AeroTech was providing a "nitrous supercharged" type of bi-hybrid motor! These loads can be identified as either the "J260HW EFX" (fewer White Lightning grains) or the "J390HW TURBO" (more White Lightning grains) designed for their 54/1280 RMS Hybrid motor. As a side note, my hat is off to Patrick Carroll for recreating these fine motors some thirty years later! I am now trying to apply the same concept to my Mini-Max line of cartridge-based bi-hybrids. In this concept motor I am basing the APCP grain also on AeroTech White Lightning propellant (a standard G54 reload in this flight) and the hybrid on the internal parts from my 16 gram 29 mm Mini-Max motor all contained in an 8" 29mm case that I made for solid propellant research flights and using a graphite nozzle with a 0.1875" throat (on the conservative low chamber pressure side). This motor was paired with my Mad Cow "Discovery" airframe and a Missile Works RRC2^{+} altimeter for deployment. As can be seen in the video the flight is very good reaching an altitude of 902'. Given this success I will start decreasing the nozzle throat diameter. If you listen carefully you can actually hear the nitrous begin to flow a few moments before the White Lightning propellant has come up to pressure!

https://youtu.be/PGxcCwWOK54

A scratch built Aerobee Hi flies to 1,560' on a 3x2 micro bi-hybrid. This is my prized scratch-built semi-scale 2-stage Aerobee Hi 1.3" in diameter by about 28" long. It is powered by the now classic and well-proven micro-hybrid "3x2 bi-hybrid" configuration. Here an Estes C6-0 motor has been modified by 1) cutting off the clay nozzle and shortening the case to 2 ¼", 2) over-drilling the stock pintel-pressed port to 3/8" deep, and 3) painting the gap at the top of the paper case with pyrogen "paint". This now creates the so-called "bi-hybrid" grain. This grain is installed in a standard Dexter Labs micro-hybrid motor and in turn, it is installed in the sustainer stage of the Aerobee. The booster is prepped by over-drilling an Estes D12-0 motor by ¼" and installing it in the booster airframe. This is the rocket you see assembled on the pad in this video.

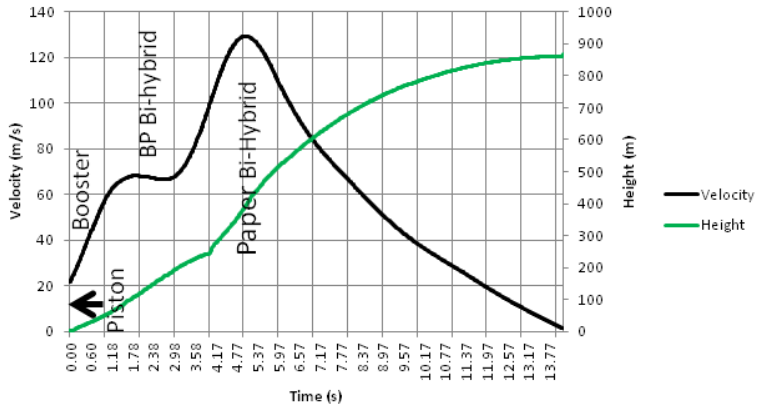
Launch is initiated by a standard Estes Startech type igniter. The booster starts at 33 seconds video time and burns for about 1.5 seconds. The direct-staged sustainer starts with a distinct puff of smoke at about 34.5 seconds video time and burns for another 1.5 seconds. The burn pauses while the pre-heater grain burns in the hybrid transitioning to the paper case burn at about 37 seconds video time. The beginning of the hybrid burn is indicated by a second, but much fainter, puff of smoke. The hybrid burns for about 2-3 more seconds and then the sustainer coasts for another approximately 11 seconds to apogee at 1,560'. The parachute deployed perfectly but the rocket drifted for a while so I cut the video just after apogee. This is a very representative flight for a micro 3x2 bi-hybrid powered rocket.

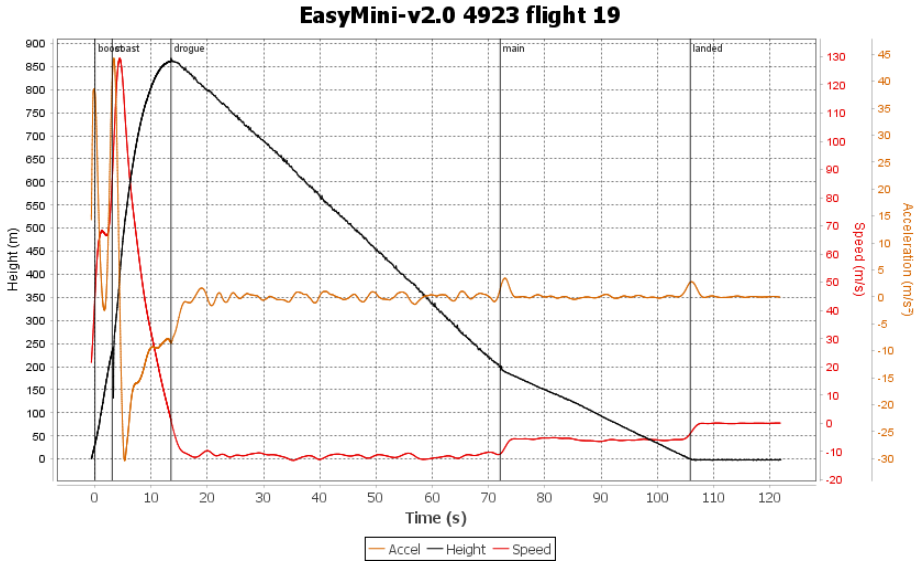
https://youtu.be/Up8Pw8SfX9k

A Piston-Enhanced Boosted Mini Bi-Hybrid Dual Deploy Superlight Reaches 2,845 feet. On October 15, 2023 at Red Lake Arizona I sent a Dexter Labs Superlight V.1 dual deploy to an astounding 867 meters (2,845') altitude. While this flight illustrates the benefit of piston launching these heavy stacks (284 grams) it is a great way to complicate your flying day! This flight has four separate power surges; 1) piston, 2) booster, 3) black powder bi-hybrid and 4) paper case bi-hybrid! By combining the power of the piston enhancement and over-drilled D12-0 booster motor the rocket attains 100 miles an hour (45 m/sec) in a little over a half second! This fast boost is really critical to getting maximum performance out of mini bi-hybrids! Since the direct stage ignition of the black powder charge in the bi-hybrid occurs as the booster is still finishing its burn there is no perceptible transition in the velocity curve but after about 1.2 seconds of video time you can see the BP bi-hybrid ignite and carry on the burn. The sustainer is now moving about 160 miles an hour (70 m/sec). The black powder does not accelerate the rocket but it is able to maintain velocity much like with the bi-hybrid Rookie flight shown in an earlier video.

The delay during the pre-heater grain burn causes the rocket to slow slightly but at 3 seconds into the flight the true hybrid comes to life burning the paper case of the Estes motor and the sustainer is off to the races peaking at around 290 miles per hour (130 m/sec) and burning for another 2+ seconds up to an altitude of approximately 450 meters. The depleted sustainer, still weighing 181 grams, then continues to coast to apogee at 867 meters (2,845')! I terminated the video while the sustainer was still under parachute for another 49 seconds! Unlike my previous attempts with this type of rocket I was able to recover this one after a successful dual deployment at apogee and 200 meters. Still, the sustainer was found over 1000 ' (305 m) away after a number of expanding circular dive patterns. Despite all my mathematical babblings first estimating 2,000' then 2,500' this rocket actually reached 867 meters or 2,845 feet…a new record for any small cartridge based hybrid rocket I have ever flown (see full flight profile below)!

https://youtu.be/yqDQ6DCGPdM





A mini-hybrid static test employing a 3D printed ABS fuel grain. Burn ignition is quick, the burn is smooth, powerful and free of chuffing etc. A very nice test yielding an E13 burn at 34 Ns total impulse. Normal speed video is followed by a slow motion version.

https://youtu.be/a3vIfBiBCas

Flight of a "Rocket R&D" Aerobee Hi powered by an AeroTech-style hybrid motor. The rocket is a 4" diameter airframe modified for dual-deployment with a 30 foot long Rocket Man streamer put out at apogee and a 54" PML parachute put out at 600 feet all controlled by a Missile Works RRC3 altimeter. The motor is a rendition of Patrick Carroll's great work reviving the long out-of-production AeroTech 54/1280 RMS Hybrid. It is burning a cardboard tube grain (160 grams start mass burning down to 108 grams end mass) oxidized by 300 grams of nitrous injected through a 4-jet injector plate. This all produced a J-210 burn lasting about 5 seconds. This flight was a celebration of Bill Colburn's 88th birthday! And so all the narration and the LCO's comments are directed toward that end! Happy birthday Bill!

https://youtu.be/NArQkcgj5EM

Levi Willey's static test of a Dexter Labs micro-hybrid burning a 3D printed PTEG star grain. Nice solid stable burn with great flame and good dark smoke! Burn time = 2 Sec, peak thrust = 14 N, average thrust = 8 N for a D8 designation.

https://youtu.be/FgCtc-0HlWU

Crawford Karachale's static test of a four-point finocyl grain 3D printed in ABS. A nice solid and smooth firing with a brief period of Mach diamonds visible in the early part of the burn. ABS makes a very nice small hybrid fuel, easy on the hardware with good flame and smoke effects.

https://youtube.com/shorts/0wSnoMEEUxI?feature=share