



Multi-Stage and Clustered Rockets

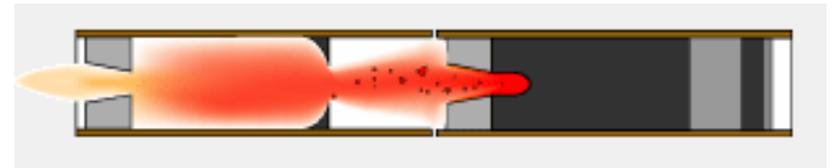
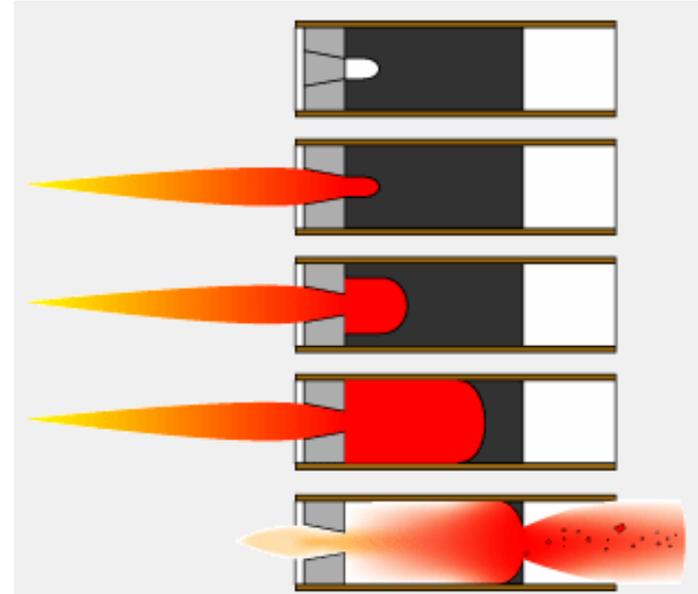
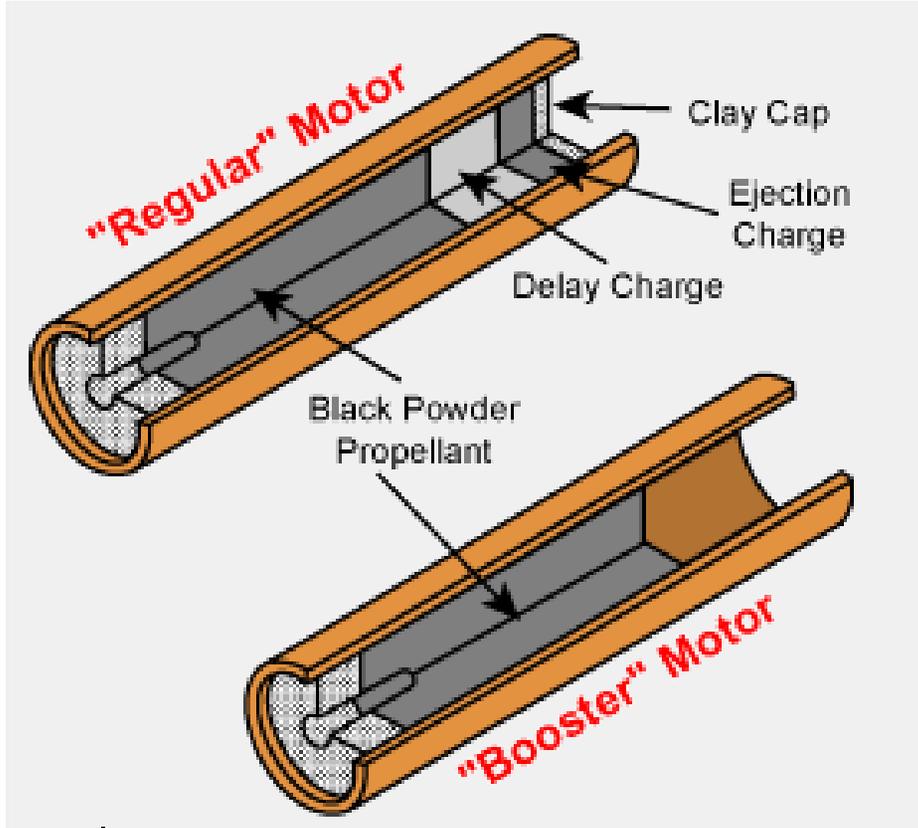


Multi-Stage Rocket

"A rocket having two or more engines, stacked one on top of another and firing in succession is called a multi-stage. Normally each unit, or stage, is jettisoned after completing its firing. The reason rocketeers stage models is to enable the uppermost stage to attain a very high altitude. This is accomplished by dropping mass throughout the burn so the top stage can be very light and coast a long way upward."



Engine Types



Prod. No.	Engine Type	Total Impulse	Time Delay	Max. Lift Wt.		Max. Thrust		Thrust Duration	Initial Weight		Propellant Weight		Retain /Pkg*
		N-sec	Sec.	Oz.	g	Newtons	Lbs.	Sec.	Oz.	g	Oz.	g	\$
SINGLE STAGE ENGINES (GREEN LABEL)													
1502	1/4A3-3T	0.625	3	1.0	28	4.9	1.1	0.25	0.20	5.6	0.03	0.85	\$7.69
1503	1/2A3-2T	1.25	2	2.0	57	8.3	1.9	0.3	0.20	5.6	0.06	1.75	\$7.69
1507	A3-4T	2.50	4	2.0	57	6.8	1.5	0.6	0.27	7.6	0.12	3.50	\$7.69
1511	A10-3T	2.50	3	3.0	85	13.0	2.9	0.8	0.28	7.9	0.13	3.78	\$7.69
1593	1/2A6-2	1.25	2	2.0	57	8.9	2.0	0.3	0.53	15.0	0.06	1.56	\$7.69
1598	A8-3	2.50	3	3.0	85	10.7	2.4	0.5	0.57	16.2	0.11	3.12	\$7.69
1601	B4-2	5.00	2	4.0	113	13.2	3.0	1.1	0.70	19.8	0.29	8.33	\$7.99
1602	B4-4	5.00	4	3.5	99	13.2	3.0	1.1	0.74	21.0	0.29	8.33	\$7.99
1605	B6-2	5.00	2	4.5	127	12.1	2.7	0.8	0.68	19.3	0.22	6.24	\$7.99
1606	B6-4	5.00	4	4.0	113	12.1	2.7	0.8	0.71	20.1	0.22	6.24	\$7.99
1613	C6-3	10.00	3	4.0	113	15.3	3.4	1.6	0.88	24.9	0.44	12.48	\$8.99
1614	C6-5	10.00	5	4.0	113	15.3	3.4	1.6	0.91	25.8	0.44	12.48	\$8.99
1622	C11-3	10.00	3	6.0	170	22.1	4.9	0.8	1.14	32.2	0.39	11.00	\$10.99
1666	D12-3	20.00	3	14.0	396	32.9	7.4	1.6	1.49	42.2	0.88	24.93	\$12.99
1667	D12-5	20.00	5	10.0	283	32.9	7.4	1.6	1.52	43.1	0.88	24.93	\$12.99
1673	E9-4	30.00	4	15.0	425	25.0	5.6	2.8	2.00	56.7	1.27	35.80	\$18.49
1674	E9-6	30.00	6	12.0	340	25.0	5.6	2.8	2.00	56.7	1.27	35.80	\$18.49
UPPER STAGE ENGINES (PURPLE LABEL)													
1504	1/2A3-4T	1.25	4	1.0	28	8.3	1.9	0.3	0.21	6.0	0.06	1.75	\$7.69
1599	A8-5	2.50	5	2.0	57	13.3	3.0	0.5	0.62	17.6	0.11	3.12	\$7.69
1607	B6-6	5.00	6	2.5	71	12.1	2.7	0.8	0.78	22.1	0.22	6.24	\$7.99
1615	C6-7	10.00	7	2.5	71	15.3	3.4	1.6	0.95	26.9	0.44	12.48	\$8.99
1668	D12-7	20.00	7	8.0	226	32.9	7.4	1.6	1.55	44.0	0.88	24.93	\$12.99
1675	E9-8	30.00	8	10.0	283	25.0	5.6	2.8	2.00	56.7	1.2	35.80	\$18.49
BOOSTER STAGE ENGINES (RED LABEL)													
1616	C6-0	10.00	None	4.0	113	15.3	3.4	1.6	0.80	22.7	0.44	12.48	\$8.99
1665	D12-0	20.00	None	14.0	396	32.9	7.4	1.6	1.44	40.9	0.88	24.93	\$12.99
PLUGGED ENGINES - FOR USE WITH ROCKET POWERED RACERS & R/C ROCKET GLIDERS (BLUE LABEL)													
1505	A10-PT	2.50	None	3.0	85	13.0	2.9	0.8	0.26	7.4	0.13	3.78	\$7.69
1669	D11-P	20.00	None	16.0	453	27.6	6.2	1.8	1.55	44.0	0.88	24.93	\$12.99

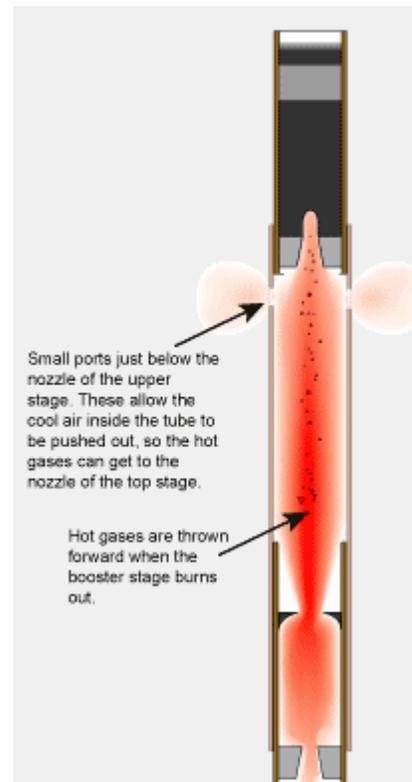
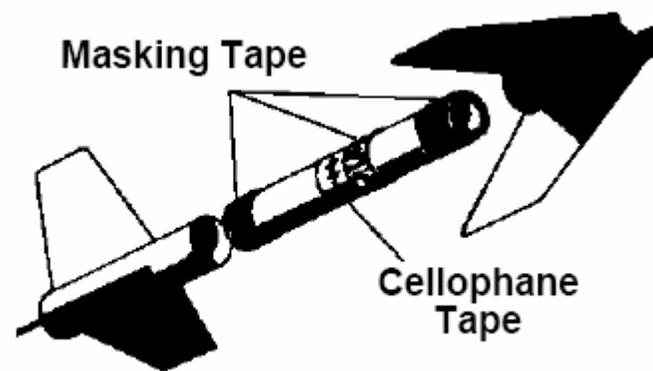


Important Considerations

- Tight coupling between stages
- Straight line separation (look into properly methodology for coupling the stages)
- Engines properly secured to rocket body
- Engines installed in proper configuration (nozzles pointing downward)

Ensure Upper Stage Ignition

- If engines in direct contact, tape them together using cellophane tape. After ignition the upper stage will melt the tape and jettison the lower stage.
- If there is a gap between engines, venting holes must be placed as close to upper stage engine as possible to allow the hot gases to push all the cool air out of the inter-stage tube.

FIG. 3

Stability



Force On Left Side Can Be Balanced By...

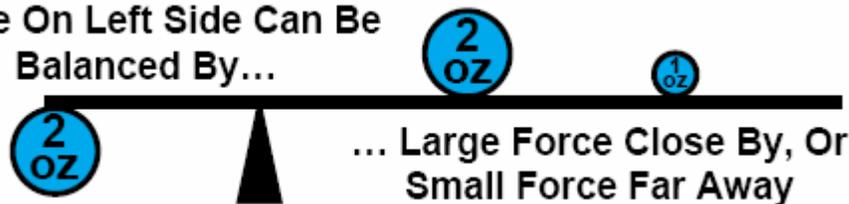


FIG. 5



Fin Area Increased On Each Added Stage



SKILL LEVEL 2 ROCKET KITS

1302 CC EXPRESS™ \$15.59

The CC Express™ is a high-flying, two-stage rocket powered by D engines. It soars to 1790 ft. (546 m) in the air.

SPECS: Length: 28.38 in. (72.1 cm)

Dia.: 1.33 in. (33.7 mm)

Wt.: 2.7 oz. (75.3 g)

Recovery: 18 in. (46 cm) Parachute

Fins: Laser cut balsa

Max. Altitude: 1790 ft. (546 m)

Recommended Engines: Single Stage - D12-5

Two-Stage: Booster - D12-0; 2nd Stage - D12-7

Requires 3/16 in. (5 mm) Maxi™ launch rod (302244) sold separately.



1382 COMANCHE-3™

\$20.99

A D engine powered booster stage rocket that roars to ultra high altitudes - over half a mile (805 m) high!

Updated with laser cut balsa fins and waterslide decals.

SPECS: Length: 41 in. (104.1 cm)

Dia.: 0.98 in. (24.9 mm) WL: 2.1 oz. (59 g)

Recovery: Booster-Tumble; Main Stage-Two Streamers

Fins: Laser cut balsa

Max. Altitude: 2660 ft. (811 m)

Recommended Engines: Single Stage Flights - A8-3, B4-4,

B6-4, C6-5; Three Stage Flights - Booster: D12-0

Second Stage: C6-0; Third Stage: B6-6, C6-7. Requires

3/16 in. (5 mm) Maxi™ launch rod (302244) - sold separately.

**2109 RENEGADE™****\$16.99**

Going staged is awesome! Witness a magnificent lift-off with the Renegade™. It's over two feet tall and can be launched as a single stage or two-stage rocket.

SPECS: Length: 26.6 in. (67.6 cm)

Dia.: 1.637 in. (41.6 mm) Wt.: 4.3 oz. (120.9 g)

Recovery: 12 in. (30 cm) Parachute

Fins: Laser cut balsa

Max. Altitude: 850 ft. (260 m)

Recommended Engines: Single Stage - A8-3, B4-4, B6-4, C6-5; Two-Stage: Booster - C6-0; 2nd Stage - A8-5, B6-6, C6-5, C6-7

Clustering

Simultaneous ignition of multiple rocket engines to attain higher thrust liftoff





Important Considerations...

- **Thrust** must be **balanced** around the centerline of the rocket
- All **engines** should be located **close** together to keep unbalanced thrust from forcing the model off course



2 - Parallel



3 - Parallel



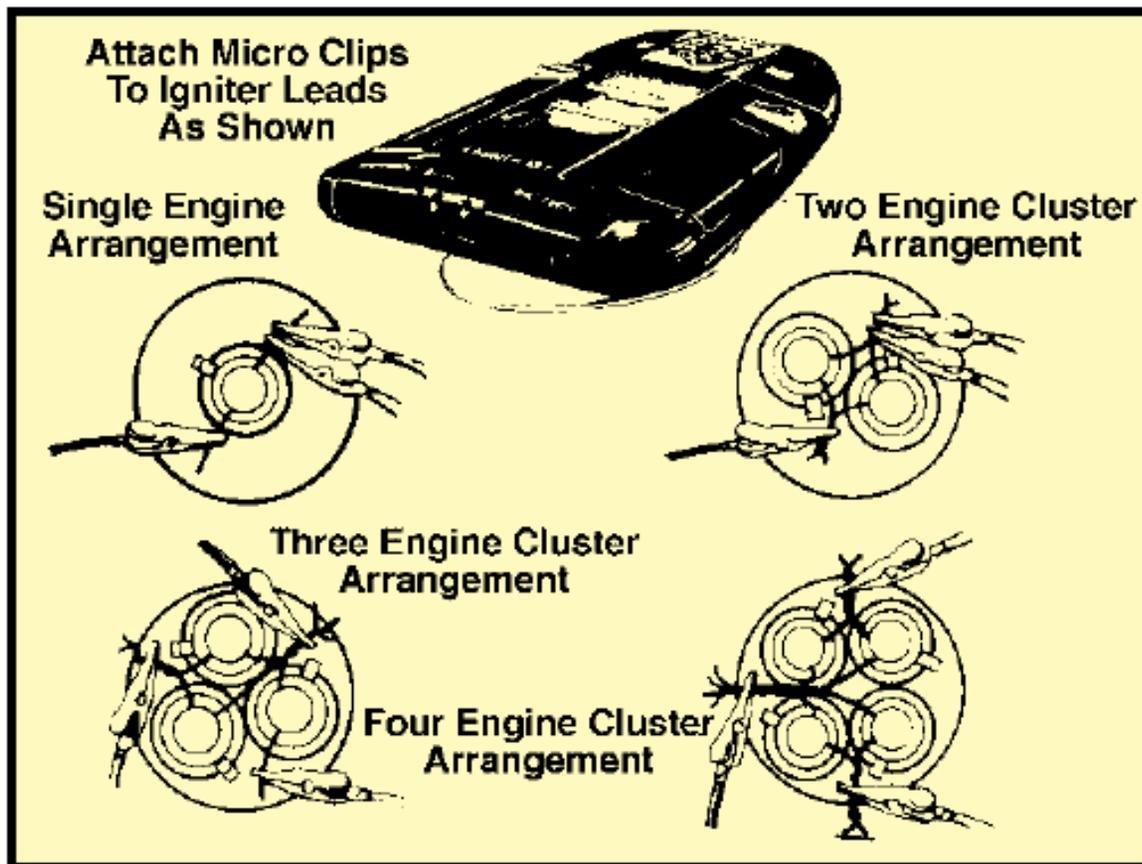
3 - Cluster



4 - Cluster

...Important Considerations

- All engines must be ignited simultaneously, which means igniters must be connected in parallel – not series





2119 36 D SQUARED™

\$25.99

The one you've been dreaming about! It's got the full package. Sleek, yet full body design, a payload section, laser cut fins and waterslide decals. This rocket launches on two Estes D size model rocket engines.

SPECS: Length: 36 in. (91.4 cm)

Dia.: 2.217 in. (56.3 mm)

Wt.: 5.7 oz. (162 g)

Recovery: 24 in. (61 cm) Parachute

Fins: Laser cut balsa

Max. Altitude: 800 ft. (244 m)

Recommended Engines: 2 each D12-3, 2 each D12-5, 2 each D12-7

(DO NOT MIX ENGINE SIZES WHEN LAUNCHING)

IMPORTANT: Requires 3/16 in. (5 mm) Maxi™ launch rod (302244) – sold separately. The Estes E™ Controller (#2230) is recommended to launch this two-engine cluster – sold separately.



2192 THUNDERSTAR

\$20.99

Designed by Starchaser Industries, the Thunderstar X Prize entry uses a cluster of two Estes engines to reach 1000 feet in the air. At apogee, a fully assembled 18 inch parachute is deployed allowing for a safe recovery. 1:41 scale.

SPECS:

Length: 26.5 in. (673 cm)

Dia.: 1.637 in. (41.6 mm)

Wt.: 2.75 oz. (78.1 g)

Recovery: 18 in. (46 cm) Parachute

Fins: Laser cut balsa

Max. Altitude: 1000 ft. (305 m)

Recommended Engines: 2xA8-3, 2xB4-4, 2xB6-4, 2xC6-5

(DO NOT MIX ENGINE SIZES WHEN LAUNCHING)