CAP Model Rocketry
Saturn Phase

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SWR-TX-391

Model Rocketry Safety Code

- Developed and distributed by the National Association of Rocketry.

- Comprised of eleven sections, aims to encourage rocketry education and usage under conditions that keep model rocketeers and the community safe.

- Comprised of the following sections: Materials, Motors, Ignition System, Misfires, Launch Safety, Launchers, Size, Flight Safety, Launch Site, Recovery System, Recovery Safety

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1) **Materials**: I will use only lightweight, non-metal parts for the nose, body and fins of my rocket.

2) **Motors**: I will use only certified, commercially-made rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer

3) **Ignition System:** I will launch my rockets with an electrical launch system and electrical motor igniters. My launch system will have a safety interlock in series with the launch switch, and will use a launch switch that returns to the "off" position when released.

4) **Misfires:** If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.

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5) **Launch Safety:** I will use a countdown before launch, and will ensure that everyone is paying attention and is a safe distance of at least 15 feet away when I launch rockets with D motors or smaller, and 30 feet when I launch larger rockets. If I am uncertain about the safety or stability of an untested rocket, I will check the stability before flight and will fly it only after warning spectators and clearing them away to a safe distance.

6) **Launcher:** I will launch my rocket from a launch rod, tower, or rail that is pointed to within 30 degrees of the vertical to ensure that the rocket flies nearly straight up, and I will use a blast deflector to prevent the motor's exhaust from hitting the ground. To prevent accidental eye injury, I will place launchers so that the end of the launch rod is above eye level or will cap the end of my launch rod when it is not in use.

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7) **Size:** My model rocket will not weigh more than 1500 grams (53 ounces) at liftoff and will not contain more than 125 grams (4.4 ounces) of propellant or 320N-sec (71.9 pound-seconds) of total impulse. If my model rocket weighs more than one pound (453 grams) at liftoff or has more than 4 ounces (113grams) of propellant, I will check and comply with Federal Aviation Administration regulations before flying.

8) **Flight Safety**: I will not launch myrocket at targets, into clouds or near airplanes,and will not put any flammable or explosive payload in my rocket.

9) **Launch Site:** I will launch my rocket outdoors, in an open area at least as large as shown in the accompanying table, and in safe weather conditions with wind speeds no greater than 20 miles per hour. I will ensure that there is no dry grass close to the launch pad, and that the launch site does not present risk of grass fires.

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10) **Recovery System:** I will use a recovery system such as a streamer or parachute in my rocket so that it returns safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.

11) **Recovery Safety:** I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places.

Altitude Tracking

- Altitude tracking is the first of two parts of model rocket performance that will help to study rocket behavior and improve from rocket to rocket.

- Altitude is measured from the highest point of a rocket's flight, known as the apogee.

- Using basic trigonometry and an altitude tracker, the height of a rocket's flight can be found easily.

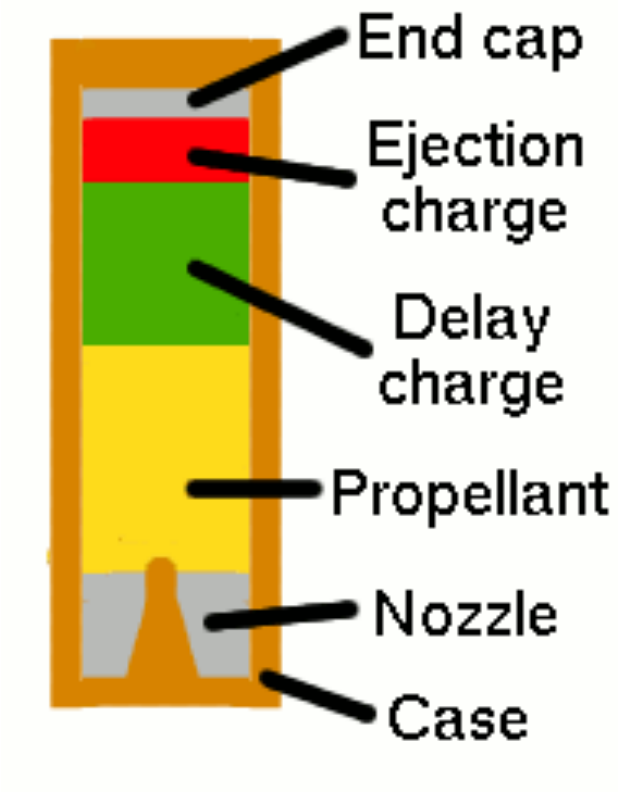
- By standing a known distance from the launch pad, and measuring an angle between the horizon and the rocket's apogee, the altitude of the rocket can be calculated.

- Mathematically, this can be expressed as:

    Baseline Distance x Angle Tangent = Altitude

Engine Performance

- A commercially made model rocket engine is made up of the following parts:
  - Ceramic nozzle
  - Solid propellant for liftoff and acceleration
  - Delay and smoke tracking chemical
  - Ejection charge
  - Clay retainer cap
  - Heavy paper casing



Engine Performance

- When the solid fuel is ignited, the resulting chemical reaction causes it to burn and be pushed out the nozzle, pushing the rocket upward.

- The rocket's height and speed are determined, in large part, by the amount of chemical propellant in the motor and the duration of the burn.

- The thrust of the rocket can be expressed in units called Newton-seconds. This is a product of the amount of force (Newtons) over a given time period (seconds).

- Codes printed on the motor provide info on how much power it can be expected to give.

Engine Performance

- A8-3, B6-4, C6-7, etc., are all established engine codes. Each number and letter defines a certain segment of the engine's total performance.

- The first letter denotes the engine's total impulse, or power. The farther along in the alphabet, the more power the engine has. This value is measured in Newton-seconds

- The number denotes the engine's average thrust. This value is measured in Newtons.

- The number after the dash denotes the time delay between the end of the rocket's propellant burn and the ejection charge ignition. This value is measured in seconds. Engine with a "0" after the dash are booster stages and have no time delay.

Engine Performance

ENGINE CHART

- Delays have a tolerance of plus or minus 10% or 1 second, whichever is greater.
- All Estes engines come complete with igniters and patented igniter plugs (Pat. No. 5,410,966 and 5,509,354). The Estes Igniter Plug makes engine ignition extremely reliable.
- Do not fly a rocket/engine combination whose liftoff weight exceeds the recommended maximum liftoff weight.

Prod. No.	Engine Type	Total Impulse	Time Delay	Max. Lift Wt.		Max. Thrust		Thrust Duration	Initial Weight		Propellant Weight	
		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
1503	1/2A3-2T	1.25	2	2.0	57	8.3	1.9	0.3	0.20	5.6	0.06	1.75
1507	A3-4T	2.50	4	2.0	57	6.8	1.5	0.6	0.27	7.6	0.12	3.50
1511	A10-3T	2.50	3	3.0	85	13.0	2.9	0.8	0.28	7.9	0.13	3.78
1593	1/2A6-2	1.25	2	2.0	57	8.9	2.0	0.3	0.53	15.0	0.06	1.56
1598	A8-3	2.50	3	3.0	85	10.7	2.4	0.5	0.57	16.2	0.11	3.12
1601	B4-2	5.00	2	4.0	113	13.2	3.0	1.1	0.70	19.8	0.29	8.33
1602	B4-4	5.00	4	3.5	99	13.2	3.0	1.1	0.74	21.0	0.29	8.33
1605	B6-2	5.00	2	4.5	127	12.1	2.7	0.8	0.68	19.3	0.22	6.24
1606	B6-4	5.00	4	4.0	113	12.1	2.7	0.8	0.71	20.1	0.22	6.24
1613	C6-3	10.00	3	4.0	113	15.3	3.4	1.6	0.88	24.9	0.44	12.48
1614	C6-5	10.00	5	4.0	113	15.3	3.4	1.6	0.91	25.8	0.44	12.48
1622	C11-3	10.00	3	6.0	170	22.1	4.9	0.8	1.14	32.2	0.39	11.00
1666	D12-3	20.00	3	14.0	396	32.9	7.4	1.6	1.49	42.2	0.88	24.93
1667	D12-5	20.00	5	10.0	283	32.9	7.4	1.6	1.52	43.1	0.88	24.93
1673	E9-4	30.00	4	15.0	425	25.0	5.6	2.8	2.00	56.7	1.27	35.80
1674	E9-6	30.00	6	12.0	340	25.0	5.6	2.8	2.00	56.7	1.27	35.80
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
1599	A8-5	2.50	5	2.0	57	13.3	3.0	0.5	0.62	17.6	0.11	3.12
1607	B6-6	5.00	6	2.5	71	12.1	2.7	0.8	0.78	22.1	0.22	6.24
1615	C6-7	10.00	7	2.5	71	15.3	3.4	1.6	0.95	26.9	0.44	12.48
1668	D12-7	20.00	7	8.0	226	32.9	7.4	1.6	1.55	44.0	0.88	24.93
1675	E9-8	30.00	8	10.0	283	25.0	5.6	2.8	2.00	56.7	1.2	35.80
BOOSTER STAGE ENGINES (RED LABEL)												
1608	B6-0	5.00	None	4.0	113	12.1	2.7	0.8	0.58	16.4	0.22	6.24
1616	C6-0	10.00	None	4.0	113	15.3	3.4	1.6	0.80	22.7	0.44	12.48
1665	D12-0	20.00	None	14.0	396	32.9	7.4	1.6	1.44	40.9	0.88	24.93
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
1669	D11-P	20.00	None	16.0	453	27.6	6.2	1.8	1.55	44.0	0.88	24.93

The data listed above is from randomly chosen production samples.
NOTE: The "T" designates a mini engine.

*** There are 4 mini engines per package. All other engines are 3 per package.**

Sources

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