ASCENT FROM THE MOON

Rocketdyne
North American Rockwell

NORTH AMERICAN ROCKWELL CORPORATION
Space Division
12214 Lakewood Boulevard
Downey, California 90241

FOR IMMEDIATE RELEASE

APOLLO MISSION PROFILE --Moon's orbit around earth during Apollo 11 mission is shown by different positions during flight in this drawing by North American Rockwell's Space Division. Bottom shows moon's position at Launch. Middle shows positions during flight and top shows moon's position at splash-down. Numbered positions show 15 key steps. (1) Liftoff (2) Earth Orbit checkout (3) Injection on path to moon (4) Turnaround and docking (5) Course correction (6) Retro-firing for lunar orbit (7) Elliptical lunar orbit (8) Lunar module separates (9) Landing on the moon (10) Ascent stage docking (11) Ascent stage is left in orbit (12) Injection on homeward trip (13) Course correction (14) Service module is jettisoned (15) Chutes lower men to earth splashdown.

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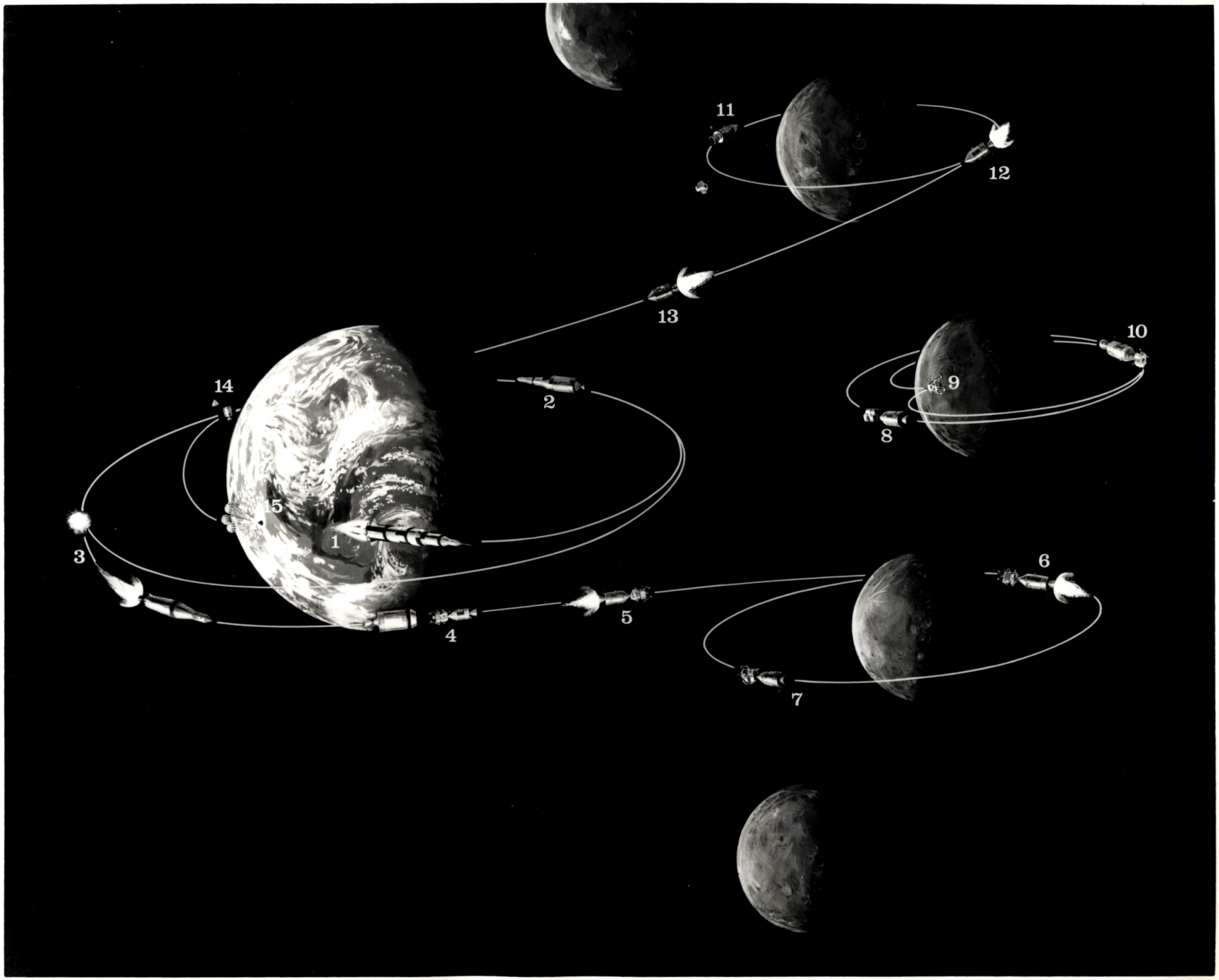
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SATURN V SECOND STAGE (S-II-6) FACT SHEET

The Saturn V launch vehicle's second stage to be used in Apollo 11's manned lunar landing mission is the sixth in a series of S-II stages.

S-II-6 STATISTICAL SUMMARY

Height	81 feet 6 inches
Diameter	33 feet
Weight (pounds)*	
Dry	79,918
Liftoff (ground)	1,069,274
Burnout	94,140
Propellant Loading (total)	979,243
LH_2	158,221
LOX	821,022
Power	
Engines (five J-2s) built by Rocketdyne, a division of North American Rockwell)	
Thrust (pounds)	230,000 per engine at 5.5 to 1 oxygen/hydrogen mixture ratio
Ullage motors (4)	Thrust (pounds) 22,700 per motor
Burntine	6 minutes, 29 seconds
Velocity	
S-IC/S-II-6 separation	9,064 feet per second (air speed, includes the earth's rotation)
S-II-6/S-IVB separation	22,757 feet per second
Altitude	
S-IC/S-II-6 separation	219,984 feet
S-II-6/S-IVB separation	609,982

SEQUENCE OF S-II-6 APOLLO II MISSION EVENTS

Normal flight time (minutes: seconds)

2:40.8	S-II LH_2 recirculation stop
2:41.3	S-II ullage motor trigger
2:41.6	S-IC/S-II separation
2:43.2	S-II engine start
3:11.9	S-IC/S-II aft interstage separation
4:21.1	S-II LOX step pressurization
7:39.8	S-II center engine cutoff
7:40.6	S-II LH_2 step pressurization
9:11.4	S-II outboard engines cutoff
9:12.2	S-II/S-IVB separation
20:16	S-II Atlantic splashdown (2,300 nautical miles downrange)

*Weights, times, velocities, altitudes estimates

APOLLO 11

SPACECRAFT WEIGHTS

(CSM 107 & LM 5)

Command module (including propellants & fluids)	12,253 lb
Service module (including propellants & fluids)	51,156
Spacecraft lunar module adapter (SLA)	4,049
Lunar module LM-5	33,277
Launch escape system	8,910
Total spacecraft weight at launch	109,645 lb
Spacecraft weight injected into earth orbit	100,735 lb (spacecraft with launch escape system jettisoned)
Command module weight at splashdown (normal mission)	10,971 lb (with parachutes disconnected)

APOLLO 11

SPACECRAFT WEIGHT BREAKDOWN

Command module (less RCS propellants)	12,007 lb
Reaction control system propellants	246
Service module (empty)	8,324
Service propulsion system propellants	40,803
Reaction control system propellants	1,341
Cryogenics (hydrogen & oxygen)	688
Total weight of spacecraft command and service modules	63,409

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FIRST BIG STEP TO MOON ASSURED BY F-1 RECORD

Apollo 11's first step to the moon---the big one of lifting off the launch pad---is virtually assured through the reliability record of the mighty F-1 engines. In five previous missions, they have operated with a launch reliability factor of 100%.

Confidence in the big engines, designed and manufactured by Rocketdyne, a division of North American Rockwell Corporation, stems not only from their launch record, but from a history of development over the past 10 years which includes nearly 70 hours of testing.

Before an engine is flown, it is tested a minimum of two times individually and once in the stage. The five F-1 engines in Apollo 11 have been test-fired a total of 13 times for 1256.7 seconds plus 126.5 seconds as a cluster in the stage. This amounts to more than twice as long as they will be required to fire in the mission--approximately 160 seconds.

The five F-1s generate 7.6 million pounds of thrust to boost the vehicle to a height of approximately 38 miles.

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ROCKETDYNE ENGINES

ON APOLLO 11

1ST STAGE:	Engines:	5 F-1s
	Thrust:	7.6 million pounds (1.522 million each).
	Propellants:	RP-1 (kerosene) and liquid oxygen.
	Size:	19' long, 12' 4" diameter; weight, 18,500 lbs.
	Mission:	Burn approx. 2.5 minutes boosting vehicle 38 miles.
2ND STAGE:	Engines:	5 J-2s
	Thrust:	1.150 million pounds (230,000 each).
	Propellants:	Liquid hydrogen and liquid oxygen.
	Size:	11' 1" long, 6' 8 1/2" diameter; weight, 3480 lbs.
	Mission:	Burn approx. 6 minutes sending vehicle to 100 miles.
	Engines:	4 ullage motors.
	Thrust:	90,000 pounds (22,500 each).
	Propellants:	Flexadyne solid propellant.
	Size:	7' 5" long, 12 1/4" diameter; weight, 500 lbs.
	Mission:	Burn approx. 4 seconds to settle propellants prior to second stage ignition.
3RD STAGE:	Engine:	One J-2
	Thrust:	230,000 pounds.
	Propellants:	Liquid hydrogen and liquid oxygen.
	Size:	11' 1" long, 6' 8 1/2" diameter; weight, 3480 lbs.
	Mission:	Burn approx. 2.75 minutes sending vehicle into earth orbit at about 120 miles. After coast, restarts and burns approx. 5 minutes for translunar injection.
	Engines:	2 ullage motors.
	Thrust:	144 pounds (72 each).
	Propellants:	Monomethylhydrazine and nitrogen tetroxide.
	Size:	15" long, 5.75" diameter; weight, 10.87 lbs.
	Mission:	Burn approx. 50 seconds after 3rd stage J-2 cutoff and again prior to J-2 restart to settle propellants.
LUNAR MODULE:	Engine:	Ascent engine.
	Thrust:	3500 pounds.
	Propellants:	Hydrazine/unsymmetrical dimethyl hydrazine and nitrogen tetroxide.
	Size:	4' 4 1/2" long, 2' 8" diameter; weight, 172 lbs.
	Mission:	Boost the ascent stage of the Lunar Module from the surface of the moon and place it in proper trajectory for rendezvous with Apollo command/service module.
COMMAND MODULE:	Engines:	12 reaction control engines (two sets of six, one set acting as backup).
	Thrust:	93 pounds each.
	Propellants:	Monomethylhydrazine and nitrogen tetroxide.
	Size:	11" long, 5" diameter; weight, 8.3 lbs.
	Mission:	Fire in bursts--up to 33 times per second--to position Command Module for earth re-entry.

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LIGHTWEIGHT ENGINE FOR LM ASCENT STAGE USED ON APOLLO 11

Sixty-eight more pounds of moon soil could be brought back from the lunar surface on Apollo 11 than would have been possible on Apollo 10 because of a lighter lunar module ascent engine.

The LM ascent engine, for which Rocketdyne, a division of North American Rockwell Corporation, is responsible, weighs 172 pounds on Apollo 11 as opposed to 206 pounds on Apollo 10. Using a two-to-one ratio (i. e. for every pound less that lands on the moon, two pounds more can leave) this allows a 68-pound increase in the payload for the ascent stage of the lunar module.

The reduction in weight was achieved by changing from an asbestos material in the thrust chamber to Narmco, a woven material. Narmco is a new glass-reinforced ablative material which has the proper characteristics required, but with a lower density.

The 3500-pound-thrust ascent engine will lift the LM ascent stage from the moon to rendezvous with the orbiting command module.

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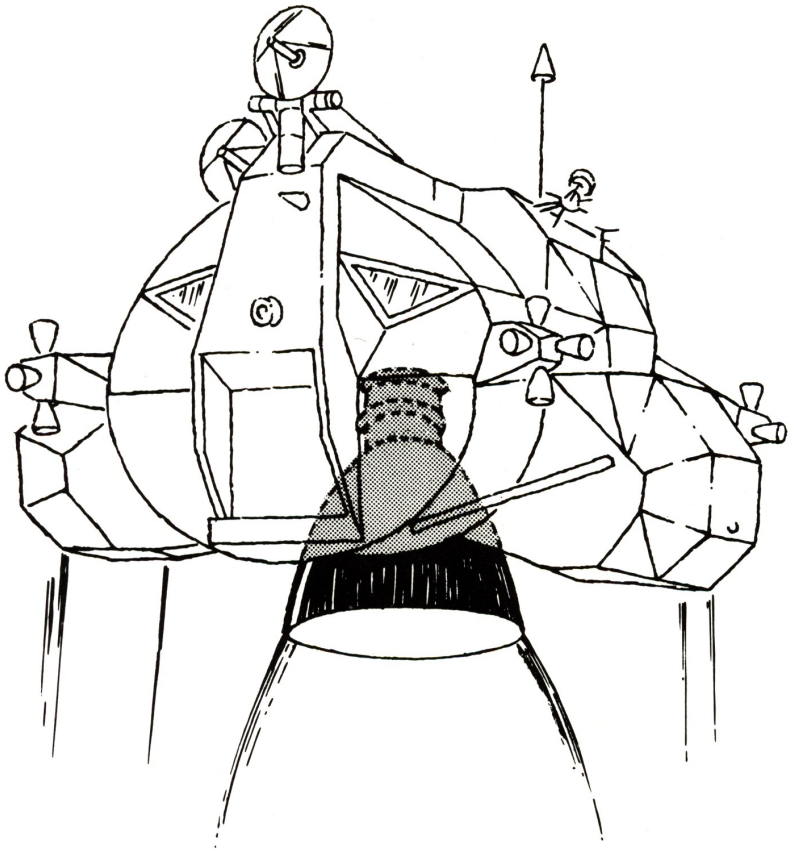
FACT SHEET
LUNAR MODULE ASCENT ENGINE



LENGTH		4 ft. 4⅓ in.
WIDTH		2 ft. 8 in.
THRUST		3500 lb.
SPECIFIC IMPULSE		309.9 sec.
RATED RUN DURATION		465 sec.
PROPELLANTS:	Oxidizer	Nitrogen Tetroxide
	Fuel	Hydrazine/Unsymmetrical dimethyl hydrazine
FLOWRATE:	Oxidizer	7.0 lb/sec.
	Fuel	4.3 lb/sec.
MIXTURE RATIO		1.6:1 oxidizer to fuel
CHAMBER PRESSURE		120 psia
APPROX. WEIGHT		*200 lb.
EXPANSION AREA RATIO		45.6:1
COMBUSTION TEMPERATURE		4835 F

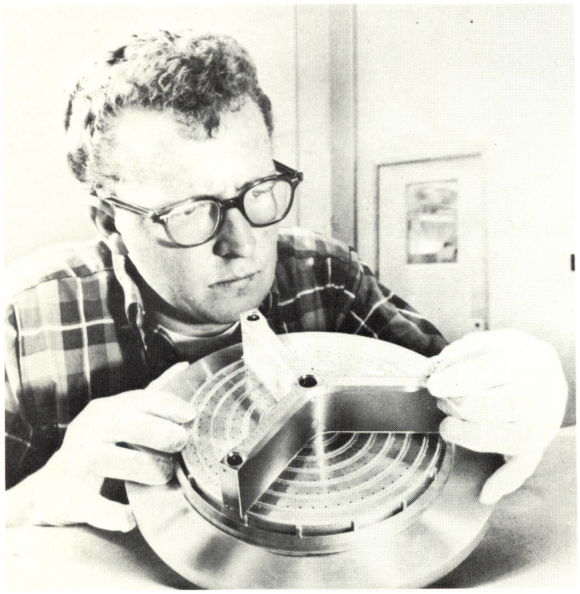
*Engines on Apollo 11 and subsequent vehicles will weigh 176 lb.

ROCKETDYNE
A DIVISION OF NORTH AMERICAN ROCKWELL CORPORATION

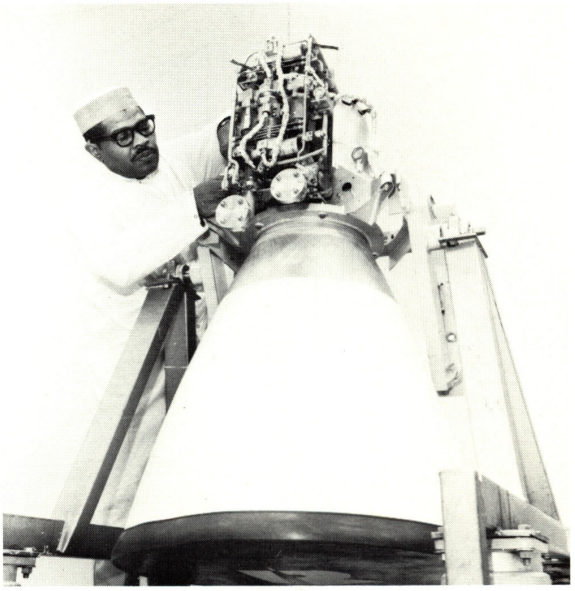
Rocketdyne, a division of North American Rockwell Corporation, designed and manufactures the lunar module ascent engine injector and manifolds, assembles the total engine, tests and qualifies it, and provides field support under a subcontract with Grumman Aircraft Engineering Corporation, prime contractor for the Apollo lunar module.

The original design of the engine is by Bell Aerosystems Company. The ablative thrust chamber is built by Hitco. Bell manufactures the ball valves.

The function of the ascent engine is to boost the ascent stage of the lunar module from the surface of the moon and place it in the proper trajectory for rendezvous with the command/service modules. Controlled by the two astronauts in the lunar module, the ascent engine fires for approximately 460 seconds for moon liftoff, allowing for an additional five second burn for final correction, if needed, to rendezvous with the spacecraft.



ASCENT ENGINE INJECTOR



LM ASCENT ENGINE

The propellant combination for the engine is storable and hypergolic. Components are the ablative thrust chamber, redundant ball valves, propellant lines, manifolds and injector, which incorporates baffles and acoustical cavities.

Rocketdyne assembles the engine at its Canoga Park, California plant and tests it at its Santa Susana Field Laboratory near Chatsworth, Calif. (sea level) and at its Nevada Field Laboratory near Reno (altitude).