

# The Database of Cost References by Group--PDF#5

Prepared by Heuston Consulting, Inc., July 2009  
Coldwarweaponsystemcosts.com

## LAUNCH VEHICLES

LV1 – Atlas/Agena – Atlas SLV-3/Agena

Cost – Total = \$3.8

Unit procurement 1<sup>st</sup> Stage = \$2.5; 2<sup>nd</sup> Stage = \$1.3, 3<sup>rd</sup> Stage = 0

In million of 1965 dollars.

Rel (pt. est. 1970 -1985) = 0.90.

Source – Prop to Study Near Term Launch Veh. Concepts, Vol. 1 – Eng. Prop, January 1966, Douglas Report SM-51938 P

Recorded – March 28, 1966.

LV2 – Titan II, SLV/Agena, /Centaur, /Agena

Cost – as follows

Discussion –

Phase B	Unit Costs				
Total	\$25.0	\$51.1	31.6		
Phase C				Titan III-C	Titan SLV Improved.
Total	\$4.9	\$6.9	\$6.1	\$8.6	\$3.0

Source –Launch Vehicle Cost/Effectiveness Analysis, March 1964, P-64-43,  
Recorded -- May 2, 1966.

LV3 – Titan II/Centaur

Cost -- \$157 million for 14 launches

Discussion – Phase B = \$52 million

Phase C = \$105 (less 69 million for Upper Stage Phase C Cost)

Source – Program Plan & Cost Analysis, Titan II/Centaur, February 1964, Prel, p XI-11. Martin Co.

Recorded – April 19, 1966.

LV4 – Titan III

Cost – as follows

			Non-recur Costs	Recurring Costs
1	Titan 3D	Titan 2 core + 2-2 segment 120 in. diam. Solid strap-on 11,000 lb	Near 0	\$7 million

		payload cap. For low earth orbit		
2	Titan 3x 3th	Martin/Denver – all liquid Titan 2 core + 2 strap on tanks each with single combust. Chamber 13,000 lb for low orbit	Near 0	\$6 million
3	All Solid 156 in Booster	All solid 156 in booster – Tandem config. Lockheed – 3 million lb thrust first stage. Lockheed 1.1 million lb thrust second stage. Thiokol 360,000 lb thrust 3 <sup>rd</sup> stage, 16,000 for low earth orbit	\$70-80 million	\$5 million

Source – Aviation Week, November 1, 1965.  
Recorded – November 26, 1965.

LV5 – Saturn

Cost -- \$27 million

Discussion – Dr. Seamans .. is in the order of \$27 million...

Source – Hearings, Com. on Aeron. & Sp. Sc., Senate, 89th Cong, 1<sup>st</sup> Ses, January 26-27, 1965.

Recorded – January 4, 1966.

LV6 – Titan II

Cost -- \$9 million

Discussion – Dr. Seamans – the Titan II cost approximately \$9 million as you buy it is a standard item. Yet on the Gemini program we are reimbursing the Air Force \$19 million, and the difference, which is nearly 2 to 1, is because of the changes that have had to be made to the Titan II to make it satisfactory for manned flight.

Source – Hearings Com. Aeron. & Sp Sc., Senate, 89<sup>th</sup> Cong., 1<sup>st</sup> Ses, January 26-27, 1965. p 104.

Recorded – January 4, 1966.

LV7 – Titan III

Cost -- \$18.2 million each

Discussion—seven segmented

Including launch costs, based on production of 6 per year.

Source – Missiles & Rockets, April 18, 1966.. p 14.

Recorded – May 3, 1966.

LV8 – Atlas/Centaur

General Dynamics Atlas/Centaur

Cost – priced at \$14-15 million

Discussion – British Ministry of Techno. Is comparing prices of US built hardware

Source – Aviation Week, May 23, 1968.

Recorded – July 23, 1968.

LV10 – Titan III C

Cost -- \$13 million

Discussion – based on limited production of 8 flight vehicles for the X-20 (Dyna-Soar) program.

Recurring costs do not include R&D nor the launch facilities and equipment purchased during the R&D program.

Recurring unit cost of \$9 million could be achieved with a production rate of 25 boosters per year for 5 years.

Payload 5,800 lbs to low earth orbit.

Source – Aviation Week, September 9, 1963, p 54.

Recorded – January 30, 1964.

LV11 – Titan III C

Cost – Delivered hardware cost of from \$8.4 to \$10.5 million per unit.

Discussion – depending on which of the various options studied comes closest to actual future procurement needs.

The total of launch services costs, including both the contractor support and Govt. support for the launching of these vehicles, varies from \$12 to \$22 million per launch for the same reasons giving the total recurring cost to user programs of from \$9.6 to \$12.7 million. Mr. Vance.

Source – Hearings before Comm. On A. & S.S. Senate, 89<sup>th</sup> Cong., 1<sup>st</sup> Session, January 26,27, 1965. p 72.

Recorded – September 16, 1965.

LV12 – Titan III – DDR&E

Cost -- \$9 million

Discussion – Dr. Brown – For a 5 year program of 25 launchings per year, the non-recurring unit costs including flight vehicles and spares, AGE spares, transportation, propellants and chemicals, facility maintenance, personnel, and systems engineering and direction.

Designed for routine launch operations using an advanced launch complex permitting highly repetitive launches without an additional large investment in facilities, which Saturn would require.

Source – DoD 64, House Hearings, Subcom. of Apron Comm., 88<sup>th</sup> Congress, 1<sup>st</sup> Session, Part 6, p 170.

Recorded – November 14, 1963.

LV14 – Titan III C

Cost -- \$13 million

Discussion – Dr. Flax – I can give you such a number, but I must caution that is based on a great many assumptions. A Titan 3 C in the sky, assuming, we make 12 a year, and assuming there is a simultaneous production of titan 3 X, will cost you \$13 million.

The Chairman. Is that the figure you use for the Communications Satellite Corp?

Dr. Flax – No

The Chairman. What was the figure you used?

Dr. Flax – This is a production price

The Chairman – I do not know the whole story, but as I understand it there has been some dispute between the Dept of Defense and the Com. Sat. Corp., they had a figure first of some \$50 million. You said, We can do it for \$26 million. They said, We will do it for \$14 million. It came down pretty fast, did it not?

Dr. Flax – this matter is still under discussion between the DoD and DCA.

Dr. Flax – The last figure I have seen, sir, would imply a cost of about \$22 million.

Source – Hearings before Comm. On Aeron. & Space Sc., Senate, 89<sup>th</sup> Congress, 1<sup>st</sup> Session, January 26, 27, 1965.

Recorded – January 4, 1966.

LV15 – Titan III C

Cost -- \$17.0 million

Discussion – Includes all vehicle and launch costs except payload and dispenser.

Source – Standard Cost Data for ADCSP Defense Study, p 5, January 28, 1965, DCA.

Recorded – February 3, 1965.

LV16 – Titan III C

Cost – Development \$900 million.

Discussion –

Source – Missiles & rockets, May 30, 1966. p 52

Recorded – June 21, 1966.

LV17 – Titan III G modified

Cost -- \$20 million

Discussion – Martin also worked on the possibility of a vehicle having only an enlarged first stage.

It would have a near earth orbit capability of 52,000 lbs.

Source – Aerospace Technology, October 9, 1967, p 17.

Recorded – October 31, 1967.

LV18 – Titan III G

Cost – General recurring cost per launch would have been \$26 million compared to the \$15 million attributed to the Titan III C.

Martin Marietta Corp.

Would utilize enlarged 15 ft diameter first and second stage cores and 156 in dia. Strap-ons.

The vehicle would have an 85,000 lb near earth orbit payload capability from ETR.

Source – Aerospace Technology, October 9, 1967, p 17.

Recorded – October 31, 1967.

LV19 – Titan III G

Cost – about \$26 million per vehicle.

Discussion – new first stage = “at core”– 4 clustered LR-87 engines with 15.1 expansion ratio nozzles.

By using 156 in. solid strap-ons, payload capability would grow to nearly 80,000 lbs.

A single LR-87 engine with 8.1 expansion ratio nozzle currently powers the first stage of the Titan II core.

Source – Missile/ Space Daily, June 5, 1967, p 124.

Recorded – June 20, 1967.

LV20 – Solid Strap-ons

Cost – Initial funding \$59,850,000.

Discussion -- 5 segment 120 in solid motor strap-ons for Titan C/D Program  
Contract calls for UTC to build 32 motors.

Value of the 3 ½ year program is expected to exceed \$100 million.

Source – Missiles/Space Daily, May 26, 1967, p 96.

Recorded – June 7, 1967.

LV21 – Solid Motor

Cost -- \$5 million per pair now.

Discussion – 5 segmented solid motors for Titan III C.

When the cost effective project gets under way on the motors in 1970, Air Force hopes to drive down the cost by \$1 million per set.

Source – Technology Week, May 29, 1967. p 25.

Recorded – June 3, 1967.

LV22 – Titan III M

Cost -- \$15 to 16 million  
Discussion – Recent NASA cost analysis made for Congress.  
Based on needs of the early 1970's and an assumption that four vehicles in the 3M – 1B class will be launched annually.  
Source – Aviation Week, April 27, 1967, p 23.  
Recorded – June 17, 1967.

LV23 – Titan II

Cost -- \$1 million per missile per year.  
Discussion – Force of 54 missiles to be maintained for a number of years at cost of \$1 million.  
Source – DMS, Special Report, DoD Budget in FY 68,  
Recorded – May 1, 1967.

LV24 – Atlas/Agena, SLV-3X/Agena.

Cost – Unit Procurement 1<sup>st</sup> Stages = 2.5; 2<sup>nd</sup> Stage = 1.3; 3<sup>rd</sup> Stage = 0; Total = 3.8.  
Discussion – in millions of 1965 dollars.  
Rel. (pt. est 1970-1985 = 0.90).  
Source – Prog. to Study Near Term Launch Vehicle Concepts, Vol 1, Eng. Prop., January 1966., Douglas Report SM 51938  
Recorded – March 28, 1966.

LV25 – Thor-Delta, McDonnell Douglas,

Cost -- \$5 million each  
Discussion – British Ministry of Technology, planning to pull out of the European Launcher Development Organization (ELDO) by 1971  
Is comparing prices of US built hardware.  
Considers Thor-Delta appropriate to launch commercial satellites into geostationary orbit  
Source – Aviation Week, May 27, 1968, p 23.  
Recorded -- July 23, 1968.

LV26 – Aerojet-General Corp. Low Cost Sounding Rockets

Cost -- \$2000 - \$3000  
Discussion – Astrobee – D  
Send 10 lb meteorological payloads to the D-region of the ionosphere.  
Use of hydroxyl-terminated polybutadiene (HTPB) fuel.  
Available meteorological rockets cost over \$5000 each, exclusive of a government furnished booster, Aerojet says.  
Source – Aviation Week, July 20, 1970., p 55.  
Recorded – September 29, 1970.

LV27 – SLV – 3

Cost – for development and testing = \$20 million  
Discussion – Dr. Gehrig --- to upgrade the Atlas to the SLV – 3.

Dr. Flax. That was \$20 million shared with NASA.  
Dr. Seamans. Fifty-fifty sharing.  
SLV – 3. latest version of the Atlas  
Standard space booster  
Five have now been fired, all successfully  
About 35 are on order.  
About 10 to be procured by NASA budget in fiscal 1966.  
Source – Hearings, Com. On Aeron. & Space Science, Senate, 89<sup>th</sup> Cong., 1<sup>st</sup>  
Ses., January 26, 27, 1965, p 109.  
Recorded – January 4, 1966.

LV28 – SLV - 3

Cost -- \$45 million  
Discussion – Dr. Seamans. We have carried out a very preliminary design of the Centaur and the 1-B and have funds actually in our 1966 budget to complete the design to detail.  
The design configuration involves a 240 in shroud that goes right up from the Saturn 1-B, an is actually a load-carrying element.  
It would be an integration cost, if we go ahead, of the order of \$45 million.  
Source – Hearings, Com on Aeron & Sp Sc., 89<sup>th</sup> Cong. 1st Session, Senate, January 26, 27., 1965, p 110.  
Recorded – January 4, 1966.

LV29 – SLV – 3, Up-rated

Cost -- \$16 million.  
Discussion – There exists a considerable potential for up-rating the Atlas (SLV - 3) by increasing the thrust of its engines and the capacity of the tankage. Part of this up-rating can be achieved through a recent proposal to the DoD by the contractor (designated SLV – 3X), which combined with the Agena, would increase its potential to the same performance spectrum as the Titan III-X-Agena. The cost of this up-rating is estimated at \$16 million.  
Source – Hearing, Com on Aeron. & sp Sc, Senate, 89<sup>th</sup> Cong, 1<sup>st</sup> Session, June 26,27, 1965, p 124.  
Recorded – January 4, 1966.

LV30 – Centaur Development Program

Cost -- \$520 million  
Discussion – Based on 8 vehicle schedule  
Almost double estimate made in middle of 1961 for a 10 vehicle program.  
By FY 63, the govt. had spent approx. \$320 million on Centaur development. For FY 64, NASA has asked \$112 million and expects to spend another \$85 million before development is completed in 1965.  
Changes in the second stage start sequence.  
Source – Aviation Week, October 21, 1963, p 75.  
Recorded – January 28, 1964.

LV31 – Atlas/Agena Cost per Shot

Cost -- \$8.5 million

Discussion – for Comsat Prop.

Source – Aviation Week, December 30, 1963, p 25.

Recorded – October 1, 1964.

LV31 – Delta

Cost -- \$3 million

Description –

Source – Aviation Week, December 30, 1963, p 25.

Recorded – October 30, 1963, p 25.

LV32 – Thor-Agena

Cost -- \$6 million

Discussion –

Source – Aviation Week, December 30, 1963, p 25.

Recorded – October 30, 1963.

LV33 – Sea Dragon Launch Vehicle Operations

Cost – as follows;

Discussion --

	Millions of Dollars
Facilities & Equipment –	
Personnel	525
Maintenance	887
Propellants	211
Transportation	5
Total	1,628

Average of 12 launches/year

Source – RAND P-2769, August 1963, p 22,

Recorded – February 3, 1964.

LV34 – ROMBUS Launch Vehicle Operations

Cost – as follows

Discussion --

	Millions of Dollars
Facilities & Equipment	190
Personnel	525
Maintenance	861
Propellants	140
Transportation	5
Total	1,721

Average of 12 launches/year

Source – RAND P-2769, August 1963, p 22.

Recorded – February 3, 1964.

LV35 – ROOST

Cost – as follows

Discussion	Millions of Dollars	
	Facilities & Equipment	189
	Personnel	515
	Maintenance	887
	Propellants	137
	Transportation	5
	Total	1,733
	Average of 12 launches/year	

Source – RAND P-2769, August 1963, p 22.

Recorded – February 3, 1964.

LV36 – Atlas Centaur Vehicles – General Dynamics

Cost -- \$62.5 million for purchase of four more

Discussion – Intelsat plans to orbit its 8<sup>th</sup> and last TRW Intelsat 3 in mid-July.

Intelsat's governing board also voted purchase of 4 more G.D. Atlas Centaur vehicles for \$62.5 million making a total of 8 for launches of Intelsat 4<sup>th</sup> starting next year.

Source – Aviation Week, July 6, 1970. p 11.

August 19, 1970.

LV37 – Launch Cost Projections – Delta, Thor/Agena.

Cost -- \$5.6 million for Delta; \$7.2 million for Thor/Agena.

Discussion – both in terms of projected 1972 dollars – were being quoted to world space leaders by NASA during the International Astronautical Federation conference here (Konstaug, Germany)

The costs were not all-inclusive and, especially for the Agena, contingent on production rates. The figures are for initial launches with the notation that follow-on launches would cost about \$150,000 less.

Added to the Delta charges would be tracking, data acquisition, technical operations, and USAF support services. Also to be included would be indirect costs prorated over all missions during a launch services contract.

Source – Aviation Week, October 12, 1970.

Recorded – December 18, 1970.

LV38 – ELGO/HORA, European launcher for geostationary orbit/  
High energy-mission oriented.

Cost -- \$800-900 million, developed in 8 years at a cost of ...

Discussion – Rudi Reichert, Chief of the Dornier design team on the project.

Vehicle could satisfy all unmanned European space launcher requirements for the next 20-30 years.

Source – Aviation Week, September 1, 1969. p 47.

Recorded – September 23, 1969.

LV39 – Up-rated Delta.

Cost – as follows:

Discussion –

Thrust Augn	3 Costor II	6 Costor II	9 Costor II	3 Costor IV	3 Cos IV, 3 Cos. II	3 Cos IV 6 Cos II
Nominal Thrust, incl core (sl)	324,000 lb	479,000 lb	479,000 lb 6 Cos II Burning	430,000 lb	430,000 lb 3 Cos IV Burning	430,000 lb 3 Cos IV Burning
Payload to Orbit 100 nm (ETR)	2,500 lb	2,850 lb	3,100 lb	3,100 lb	3,350 lb	3,550 lb
Cost/Launch 1969	\$4.3 million	\$4.6 million	\$4.9 million	\$4.7 million	\$5.0 million	\$5.3 million

Source – Aviation Week, March 24, 1969, p 59.  
Recorded – June 5, 1969.

LV40 – Saturn 5 Workshop

Cost – Run out cost of about \$3.5 billion.

Discussion – A responsible NASA official estimated that a space station would cost at least \$5 billion and possible \$10 billion.

Work shop based on available hardware modified for advanced experiments could be ready for flight by 1973.

Source – Aviation Week, December 23, 1968. p 17.

Recorded – April 8, 1969.

LV41 – Long Tank Thor-Delta, McDonnell Douglas to Launch Eurafrica Comm. Sat. From French Guiana

Cost – full price estimated at \$10-20 million

Discussion – Since pad facilities these will have to be evaluated.

Source – Aviation Week, November 11, 1968. p 23.

Recorded – January 7, 1969.

LV42 – Delta, NASA

Cost -- \$5,000 cost per pound in orbit

Discussion – Mr. Webb speech

Source – Hearing House Approp. Comm., 88<sup>th</sup> Congress, Part 3, p 83.

Recorded – October 17, 1963.

LV43 – Delta, NASA

Cost -- \$2.5 million, unit price

Discussion –

Source – Senate Aero. & Space Science Com. Hearings, 88<sup>th</sup> Congress, 1st Ses., Part 1, p 288.

Recorded – November 5, 1963.

LV44 – SCOUT

Cost – \$1 million -- Scout Space Launch Vehicle – NASA  
 Discussion – 250 lb payload, 300 mile circular orbit  
 Up rate second stage to a total payload capability approaching 300 lbs.  
 Source – Senate Aero. & Space Science Com. Hearings, 88<sup>th</sup> Congress, 1st Ses.,  
 Part 1, p 216.

LV45 – Delta Launch Vehicles

Cost -- \$1.125 + million  
 Discussion – NASA will buy 8 more Delta launch vehicles from Douglas Aircraft, bringing to 47 the number of these well-proven boosters it has acquired. Although the new contract, expected to exceed \$9 million, doesn't cover modifications, the boosters to be bought will be capable of thrust augmentation and some will be converted to TAD's. NASA expects to use the vehicles for orbiting Biosatellites and Pioneers, as well as future meteorological and other satellites.  
 Source – Missiles and rockets, March 2, 1964, p 9.  
 Recorded – May 28, 1964.

LV46 – Marlet 33 Booster

Cost -- \$1,000 per vehicle  
 Discussion – launch vehicle weight = 240 lbs  
 5,000 ft/sec muzzle velocity is hoped for, with a 200 mille altitude capability for a 45 lb payload.  
 Rocket booster Marlet 3B, is 2 in wider than its predecessor, the 6 in diameter, 3A, and uses a steel airframe rather than aluminum.  
 First flight tests of a new 16 in rocket motor to be used to boost 100 lb vertical-gun-launched payloads to altitudes of 1,000 mi or 1,000 lb payloads to 3,000 ft is expected in May at US Army-Mill University (Montreal) Project-Harp test complex at Barbados Island.  
 Source – Missiles & Rockets, January 27, 1964, "16" in Harp Booster Nears Flight".  
 Recorded – June 1, 1964.

LV47 – Atlas Launch

Cost – I Atlas -- \$12 million  
 \$0.9 million

	I	II
Discussion – No. of launching in sample	20	20
No. of launching prior to sample	32	64
Period covered by sample (incl. dates)	10/29/59	6/22/61
	9/25/60	12/5/62
Period covered by sample (months)	11.0	17.5
I – RM-2762		
II – present study		

Source – RAND RM-3913-PR, Eff. In Space Rocket Launching Op, Recent Advances & Future Applications, December 1963.

Recorded -- June 23, 1964.

LV48 -- Titan I Launch

Cost -- I -- Titan I -- \$1.0 million  
II -- Titan II -- \$1.0 million

Discussion --	I	II
No. of launchings in sample	20	20
No. of launchings prior to sample	6	27
Period covered by sample (incl. dates)	2/2/60 12/20/61	2/10/61 1/29/62
Period covered by sample (months)	10.7	11.5

I -- RM-2762

II -- present study

Source ; RAND, RM-3913-PR, Eff. In Space Rocket Launching Op, Recent Advances & Future Applications, December 1963.

Recorded -- June 23, 1964.

LV49 -- Titan II Launch

Cost -- II -- Titan II -- \$1.9 million

Discussion -- No. of launchings in sample -- 9  
No. of launchings prior to sample -- 0  
Period covered by sample (incl. dates) -- 3/16/62 -- 12/19/62  
Period covered by sample (months) -- 9.0

Source -- RAND, RM-3913-PR, Eff. In Space Rocket Launching Op., Recent Advances & Future Applications, December 1963.

Recorded -- June 23, 1964.

LV50 -- Scout Launch

Cost -- \$0.1 million

Discussion -- No. of launchings in sample -- 9  
No. of launchings prior to sample -- 1  
Period covered by sample (incl. dates) 9/21/64 -- 4/12/62  
Period covered by sample (months) -- 18.7

Source -- RAND, RM-3913-PR, Eff. In Space Rocket Launching Op., Recent Advances & Future Applications, December 1963.

Recorded -- June 23, 1964.

LV51 -- Thor-Able/Able Star Launch

Cost -- \$0.5 million

Discussion -- No. of launchings in sample -- 10  
No. of launchings prior to sample -- 17  
Period covered by sample (incl. dates) 6/22/66 -- 10/31/62  
Period covered by sample (months) -- 28.3

Source -- RAND, RM-3913-PR, Eff In Space Rocket Launching Op., Recent Advances & Future Applications, December 1963.

Recorded -- June 23, 1964.

