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Reaching for the stars? 50th anniversary of Israel's "Shavit 2" rocket

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Abstract

On July 5, 1961, Israel launched the Shavit-2 (Comet) rocket to a short flight to the edge of space. The purpose of the launch, as described by the prime minister's office was "to conduct scientific research". Official technical data was not published by RAFAEL (RAFAEL advanced defense systems Ltd (Than – RAFAEL, Armament Development Authority) - the designer and contractor for the rocket - until now, 50 years later. A detailed video was declassified only in 2010. Amazing as it sounds, Shavit-2 is **still** shrouded with mystery.

In the beginning

The pre dawn hours of July 5th, 1961, at a secret location in the northern shoreline of Israel, known for decades as "Bird of Fire" proving ground, were tense. The presence of Israel's prime minister and minister of defense David Ben Gurion, alongside with IDF (Israel Defense Forces) chief of staff, deputy minister of defense, minister of foreign affairs and other VIP's didn't add to the confidence of the engineers on the test site. On a launch pad, there was a bright orange colored rocket, scattered with black markings. It was the Shavit (Comet) 2, Israel's first sounding rocket designed to be launched to the edge of space. For 50 years the result of the launch were kept as state secret. On the jubilee of the event new information is finally available, and the results of the flight are quite different than the known historiography.



The official pre launch photo distributed by the ministry of defense. Second from left is Israel's Prime minister & Minister of defense, David Ben Gurion

Why launching a rocket to space?

Officially, Israel entered the space realm on September 19, 1988, with the

launch of its first indigenous satellite, Ofeq 1 (Horizon).¹ Launching a “space rocket” as early as 1961, 13 years after the founding of the state of Israel, requires some explanation, especially since there were no other space efforts until the late 1980’s. The questionable motivation for space launch in 1961 strengthening since there was no follow on launches after Shavit 2, or public information on more advanced sounding rockets. It is also interesting to note, that the prime contractor of Israel launch vehicle (“Shavit” - with NO linkage to the historic Shavit-2 – is IAI, and not Rafael, who built the Shavit-2).

Early developments of Sounding rockets at RAFAEL

Prior to the dramatic launch of Shavit-2, there was a modest effort in RAFAEL to develop a line of high altitude rockets, for various purposes, like dynamic testing of solid fuel cores, staging, telemetry and alike. There was an initiative of the Israeli Astronautical Society², which, as of 1959, presented a proposal to RAFAEL to collaborate on various sounding rockets projects. On January 1960, members of the Israeli Astronautical Society stated to journalists that a launch of a rocket to a height of around 50 kilometers during 1960.³ Rafael’s chief (Mardor) was furious on the publicity and order to stop any cooperation with the society. The work on the rockets (including the two stage rocket proposal, which became Shavit-2) continued clandestinely.

¹ See for example IAC paper IAC-10 E3.4.8, “Abir – The satellite that almost was”, for a comprehensive portray of the first years of Israel’s space program.

² Founded in 1959, and was the first Israeli member at the international astronautical federation

³ “Lamerchav” daily newspaper, 25.1.1960

Design characteristics of Shavit-2

Shavit-2 was a two stage, solid propelled rocket. The few photographs that were published were misleading – estimation of the length of the rocket led to about 10-12 meters. The actual figures were MUCH more modest, and it is no wonder that it was kept under Vail of secrecy for decades. The total length of the Shavit-2 was 376 centimeters, with diameter of 27 centimeters for the first stage, and about 12 centimeters for the second stage. Launch mass of the rocket was 250 kilograms.

Under the nose cone was a charge of high explosives surrounded by Sodium powder. It was meant to be detonated in the upper atmosphere, at a height of around 80 kilometers.

For Shavit-2 first stage, RAFAEL engineers took the solid rocket motor that was designed for Israel’s first short range ground to ground and ground to sea missile, the LUZ (walnut). For the second stage, they coupled two solid propellants cores that were simply called R-115 (R for “Rocket”. These cores were developed for the for the first heat seeking air to air missile, the Shafrir-1 (dragonfly) which was at the time in the preliminary phase of development.

Reliability

A mentioned by Rafael’s director general, he was given a reliability estimate from Shavit-2 chief engineer, Yaron Ansalem (who, for decades, due to security policy, was known in public as “the engineer Yaron”. His full name was revealed only after his death. A homage to Korolev as the “chief designer”?.....). The reliability study has shown that there was a 50% chance that the first stage will operate as planed; by preparing two rockets he estimated the chance for one successful

launch to be 75%.⁴ At the test site two identical rockets were poised, but the first one was lifted off successfully so the second rocket was not needed. Original plan stated that three rockets are needed on the test site, since VIP's will be present, including RAFAEL's patron within the ministry of defense, Shimon Peres.⁵

The strategic connection

The main enemy country at the time, Egypt, has been involved with rocketry projects for some time as of 1961. Six US made sounding rockets (Javelin-viper) were purchased by Egypt, and several of these were supposed to be launched on July 23, 1961, the Egyptian revolution day. Israel's clandestine agency – the MOSSAD – has learned about the plan, and warned the government that Egypt is going to present the rockets as indigenous design, and declare its superiority over Israel in the field of missilery.

The Israeli response was a crash effort to built and launch a rocket of its own, before the Egyptians. THIS IN FACT WAS THE MAIN RATIONAL BEYOND THE SHAVIT-2.

The mission – to launch a rocket before Egypt does so - was appointed to RAFAEL – the state owned Armament Development Authority. Rafael's general director at the time, Meir (“Munia”) Mardor, stated that building and launching small sounding rockets was in fact a part of Rafael's activities, but for internal purposes and at a very low priority (in terms of budget and man power).⁶ Mardor said

⁴ Meir Mardor, “RAFAEL”, ministry of defense publishing house, Tel Aviv, 1981, p. 329.

⁵ Ibid, pp 322-323

⁶ See Mardor's book, “RAFAEL”, ministry of defense publishing house, Tel Aviv, 1981, p. 319.

that originally, a dynamic test of the rocket was designed to be conducted around March 1961.

The political aspect

The launch took place on July 5th 1961, short time before general elections that were held on August 15 of the same year. A lot of criticism was published in national newspapers, blaming the ruling party for manipulating the public with launching rockets into space, to diverse discussions over problems that it failed to solve. Many journalists called the Shavit-2 an “election missile”.

A brilliant public affairs stunt

Footage of the launch was shown on cinemas across Israel (In 1961 there was no TV broadcasting in the country). Special late editions of newspapers were printed, and were distributed free on the streets. Congratulations comments from around the world celebrating Israel's entry to space were published in national radio. The atmosphere was ecstatic. It seems that everyone expected to see more space launches in the near future. The official declaration that was published by the government was brief and scarce in elaborating: *“Today, July 5th 1961, on 04:41, a meteorological rocket was successfully launched to space, from an installation near the Mediterranean sea. The rocket was designed, built and launched by a team of Israeli scientists and technicians. The prime minister and minister of defense, the minister of foreign affairs, the deputy minister of defense⁷, and scientists were present at the launch. The goals of the experiment were accomplished”*.

⁷ Shimon Peres, now the president of the state of Israel

No credit to Rafael was neither given, nor technical data on the rocket itself, the launch site location and the general context of this experiment.



Launch of Shavit-2. The only available still photo for 5 decades

An official medal was minted by the state mint, and distributed by the prime minister (and minister of defense) to those who took part in the design and operation of the Shavit-2. Another version of the state medal was offered to purchase by the general public, and became an instant success.



The official state minted medal that was awarded by Israel's Prime minister and Minister of defense, David Ben Gurion

Anger within Rafael

The atmosphere in Rafael was not of great joy and enthusiasm outside the small team that was appointed to work on Shavit-2 as an emergency project. Zeev Bonen, then a missile engineer at Rafael, and later the director general,

wrote to Mardor about his feelings: "...It is difficult to demand from people here (at Rafael, T.I.) to work hard, with strong devotion, on the existing project, when suddenly there are cutbacks, with no explanations from the management, and a lot of effort is diverted to the rocket project."⁸

Follow on rockets?

There were some unpublicized rocket launches in Rafael's proving grounds after the Shavit-2 launch. On the archives of Rafael there is a picture of a THREE stage rocket, similar in appearance to the Shavit-2, dubbed "Shavit-3". The only information as of late 2011 regarding this rocket is that a dynamic test of it was conducted in 1965.⁹ Rafael's chief at the time stated in his book that the three stage rocket was designed to be launched to a height of 200 kilometers with an "electronic payload" of about 10 kilograms.¹⁰ Additional feature in the advanced rocket was an active radar transponder, to ease tracking of the rocket and payload.¹¹

⁸ The letter is dated July 13, 1961, and is mentioned by Mardor

⁹ Danny Shalom, **Over The Horizon: 50 years of space activity in Israel**, Aviation publications, Rishon le-Zion, Israel, 2003, P. 13

¹⁰ See Mardor's book, "RAFAEL", ministry of defense publishing house, Tel Aviv, 1981, p. 320.

¹¹ Ibid.



The family of sounding rockets developed by RAFAEL. From left: Shavit-1, Meteorological rocket RM 551, Shavit-2, Shavit-3.¹²

There are no records on sounding rockets activities in Israel or by Rafael until today. The program of Rafael was not led to development of a production line of scientific rockets.

The launch video

The central archive of IDF and ministry of defense in Israel created its own channel on Youtube.¹³ A short video of the July 5th launch of Shavit-2 was uploaded to the internet in 2010. It shows preparations to the launch and the launch itself. Most parts of this short film were never shown to the public for 49 years (!). The secrecy is quite strange, considering the fact that it is an obsolete sounding rocket, with late 1950's technology. However, the Youtube video is not showing the entire flight. Several sources in Israel claimed that the rocket failed and

exploded in mid air¹⁴ before burnout of the first stage, hence the second stage was not operated. There is no official confirmation to this claim, but it was also mentioned on a lecture by one of Israel's top missile designers.

Epilogue

Twenty Seven years after the launch of Shavit-2, another, much larger launcher lifted off near the sea shore of Israel. It was carrying the first satellite of Israel, and although the two first stages of the missile were a product of IMI – Israel military Industries, the third stage (the apogee kick motor) was a product of RAFAEL. The name of the launch vehicle was SHAVIT.

Today RAFAEL is involved with many space related projects, mainly in the field of propulsion (Solid and liquid, as well as Ion thrusters). The company is also developing a new line of micro satellites and carried a feasibility study for a small. Airborne launch vehicle.

¹² This drawing was published by Danny Shalom, in **Over The Horizon: 50 years of space activity in Israel**, Aviation publications, Rishon le-Zion, Israel, 2003.

¹³ See <http://www.youtube.com/user/IdfModArchives>

¹⁴ For example – Danny Shalom was quoted in the website of "Israel Defence" that the launch failed. Shalom was the first journalist that was granted with access to Rafael's archives.