Saturn The stages that were not meant to be:

This incomplete chronological discussion of stages meant for the Saturn Rocket that were either never designed, never built, or canceled as foolish ideas, but someone still wrote them down!

This will not be a complete list as there are a LOT of stages, we don't have a lot of information on, and some "stages" are hypothetical ones that people not associated with the Saturn Program arm chaired into it because they had media connections…. Lookin' at you, NOVA!

This document will be broken down into Rocket families.

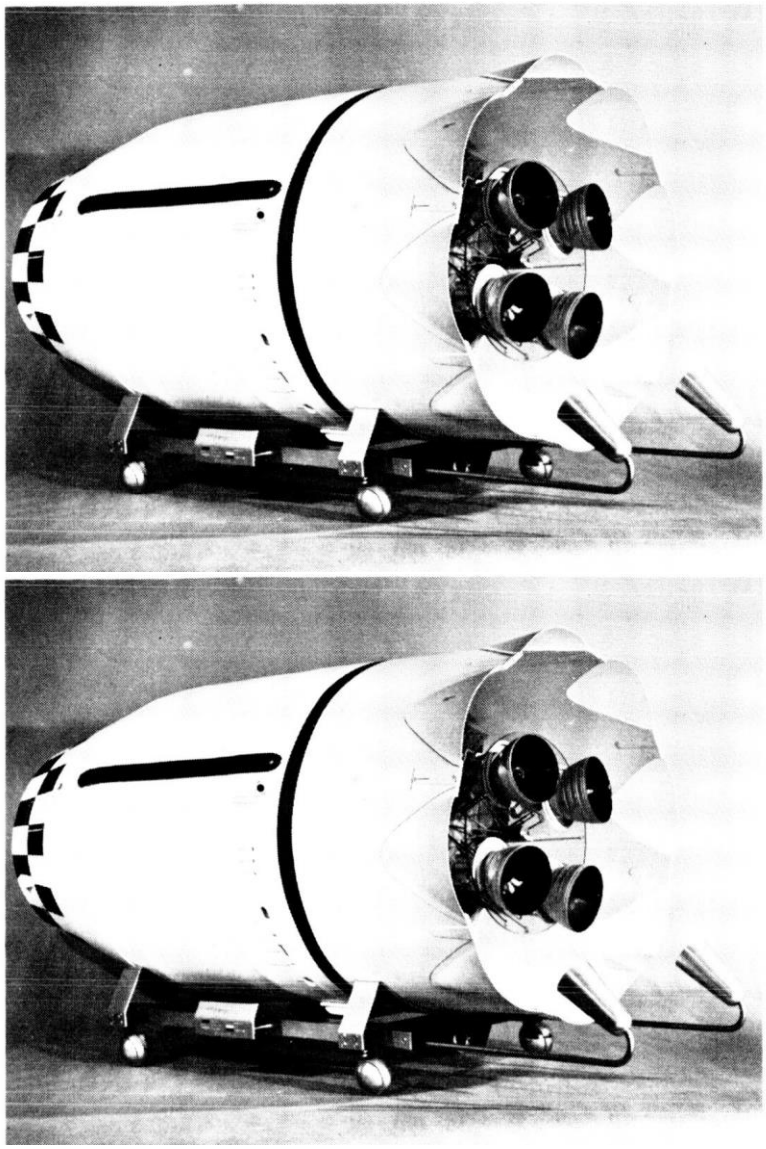
- The Saturn C series, including Saturn I and Saturn V
- Saturn A/B series. Not a lot of engineering was done here
- Oddballs and un-filed stages

Saturn C series C-1 and C-2 stages:

While the Saturn C-1 evolved into the Saturn I and Saturn IB rocket stages… several components were designed but not built. Before late June 1961, the Saturn C-2 was also being developed. Its cancelation is the result of focusing Saturn on the moon.

Original S-IV stage. The Original S-IV was a four-engine LR-119 powered (the RL10B-3 for those who don't speak US Air Force designations) small-diameter stage. Its top diameter would have been 3.05m to match with the S-V stage (more to come on that in a bit), and its main tank diameter would have been 4.7m or 185". To meet the S-I stage, a combined conic structure on the S-I stage would conjoin with a flared skirt structure with conic-shaped blowout panels.

Here is a picture of the Mockup:



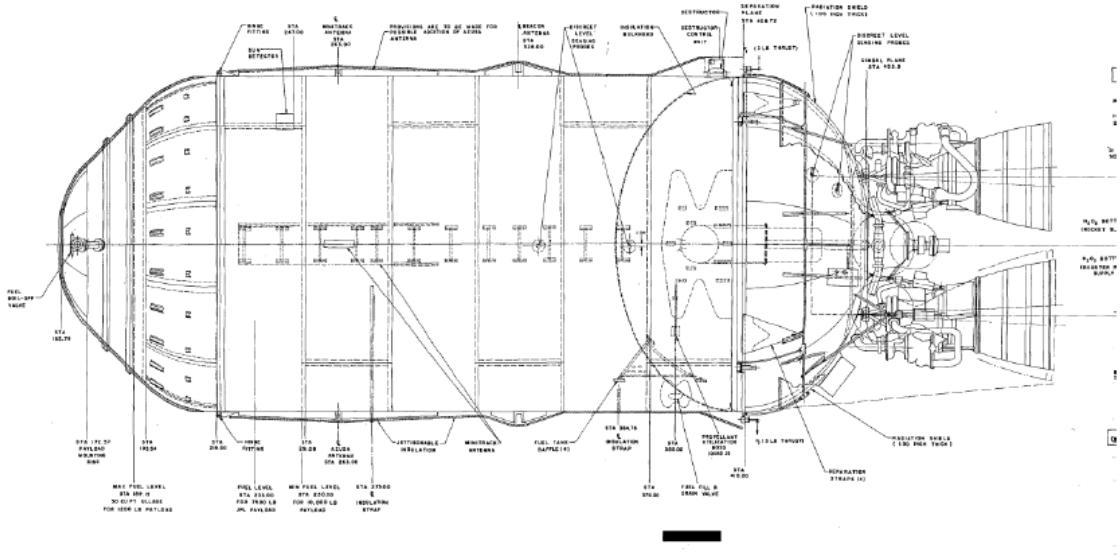
Description of the changes: 4, instead of 6 engines, a subtle taper from the cylindrical to the conic tank, almost an ogive curve instead of straight-sided, and the 3d conic instead of half-circle blow-out panels on the aft skirt. Due to fears of the delay of the LR-119, the enlarged S-IV was ordered and built… and this is one of several "early" mass adds to the Saturn I rocket.

Photo from NTRS document 19650020284

Saturn S-V (Centaur) Stage: Much has been written about this… and much has been obscured. Before the Centaur's initial launch and failure, the Centaur C series was meant for the Saturn Rocket. The Centaur was designed to put a large payload into deep space orbit. Remember, this was before we had even figured out how to calculate planetary slingshot maneuvers or at least test their theory. The Saturn Rocket was meant to launch a satellite on a direct flight trajectory to any planet in our solar system. No slingshots, no reserves, no nothing. Knowing that space was cold, boiloff was mostly not considered… with tragic results. Ultimately, The Centaur C series would not be built. But wait, a Centaur C did fly as part of the return-to-flight test program for Atlas, right? Well, yes and no. Yes, a

Centaur labeled the #C (as in a numerical designation) did fly. It, however, was not a Centaur C. It was a Centaur NUMBER C. Yes, that is confusing as all get out and the Great folks at Glenn Lewis SFC should NOT have re-designated the Centaur Program when they took it over… but they did. As did Lockheed when they re-asserted control (owning General Dynamics) in the late 1990s.
Centaur C itself was physically about the same size as the Latter Centaur D.1T for the NASA Titan launches of the 1970s. Like the D.1T it was not supposed to have external insulation unless carried exposed… then Like the D.1A it would carry jettisonable Insulation. What is the real difference between the Centaur D.1A of Atlas, the Centaur D.1T of Titan, and the Centaur C (S-V) of Saturn? The skin of Centaur C was almost double the thickness, making the Centaur C, not a balloon-tanked Centaur. Centaur C and the latter Centaur E were monocoque tank structure stages closer to Agena than Centaur D in tank-wall thickness. Likewise, the LR-119 engine, AKA the RL10-B-3, which was never actually built, would be used to cater to the higher mass of the stage.

As a follow-up to the Saturn S-V Centaur C, after the issues with space flight and Hydrolox fuels had been "Solved," Glenn Lewis SFC and Marshal SFC developed but never built or flew the Centaur E. The Centaur E was a Centaur C with updated 1970s electronics for use with the MLV/INT Saturn Programs. In the design stages, it was still planned to use the RL10-B-3, but the Centaur E's tank wall, while still thick, wasn't as heavy as the Centaur C's due to the improved design of the tanks and inter-tank structures. The overall change in mass of the Centaur E vs the Centaur C was a few kilograms. But it was enough of an engineering change to denote a new designation.



Saturn S-V Big Centaur: Three documents in the USAF archives and the NASA NTRS servers mention a Big Centaur for the Saturn V. This would have been a stretch of the Centaur E above with further uprated engines. All references to this are vague and should be considered less as a fact and more as a "hey, can we do" idea.

Saturn S-V Dynasoar. The Saturn C-1 design, for several months, was the chosen launcher for the USAF's Dynasoar program, and several features that were to fly on the Saturn I rocket were the result of this. The Dynasoar would have had a structural, communication, and avionics module to attach to the top of an S-V Centaur (given the time frame Centaur C.) The "SCA" would replace the centaur avionics and provide USAF-specific ground control features. Other features built into the Saturn C-1 design that flew on the Saturn I were giant fins. The Saturn Rocket did not need these fins to fly; instead, they were required to counteract the wing surface of a Dynasoar, and to save time, the stage was not re-engineered to fly without them. With Dynasoar, these fins were to have hydraulically actuated control surfaces. In the end, the fins on the rocket were simplified versions without any control actuation or movable surfaces. With the Advent of the more advanced Saturn IB or Saturn C-1Blk2, the fins, still retained, shed even more mass.

Saturn I S-IVB 220" Diameter.

Initially ordered as a simple re-engine of the S-IV stage, the S-IVB would have had a tank stretch to increase the fuel. Switching to the core stage 260" diameter allowed a height reduction of almost 15 feet and increased strength without added mass.

Saturn C-2 S-III stage:

Early on, it was hoped the Saturn C-2 would be ordered about a year and a half behind the C-1 to allow for the development of the S-III stage and its J-2 engine. The S-III stage would be used on the C-2, C-3, and, for one month, the C-4 rockets. The S-III stage can best be described as a 2/3rds height S-IVB with 2 J-2 engines. 2x the thrust 2/3rds the fuel capacity. This is a dramatic over-simplification in terms of accuracy. While no contract was ever let for this stage, we can surmise that McDonnell would likely produce it. We know that McDonnell was contracting with Douglas for "Technical considerations" for rocket design. While this might have been extra engineers to help with Gemini, the author feels it was for the soon-to-be-canceled S-III stage. S-III was likely canceled to avoid duplication of stages (the S-II stage had a similar role on the C-3 and C-4 rockets) and to free up McDonnell for the Gemini program. The timing of the cancelation of the S-III coincides with the Silverstein Commission ordering Douglas to make the S-IVB.

Saturn C-2 S-II stage. With the cancelation of the S-III listed above, the Saturn C-II needed a new stage. Thus, the four-engine S-II stage came into existence, which North American Aviation designed to match the 260" diameter of the S-I stage. The C-2 S-II stage would be approximately the same height as the S-I stage (about 74 ft) and be powered by 4x J-2 engines. NAA documents call this the S-II-260 as separate from the S-II-396 of the Saturn V.

The Saturn C-3 Rocket family:

The C-3 has a large diameter, and all new rockets are not derived from the C-I Cluster tank arrangement. A Clean Sheet design, the C-3, was developed for an Earth-Orbit Rendezvous to build a large ship to fly to the moon and back. Several C-3 and C-2 launches would be required to construct this space-based ship to go to the moon, perform landings with a lander, and return to Earth.

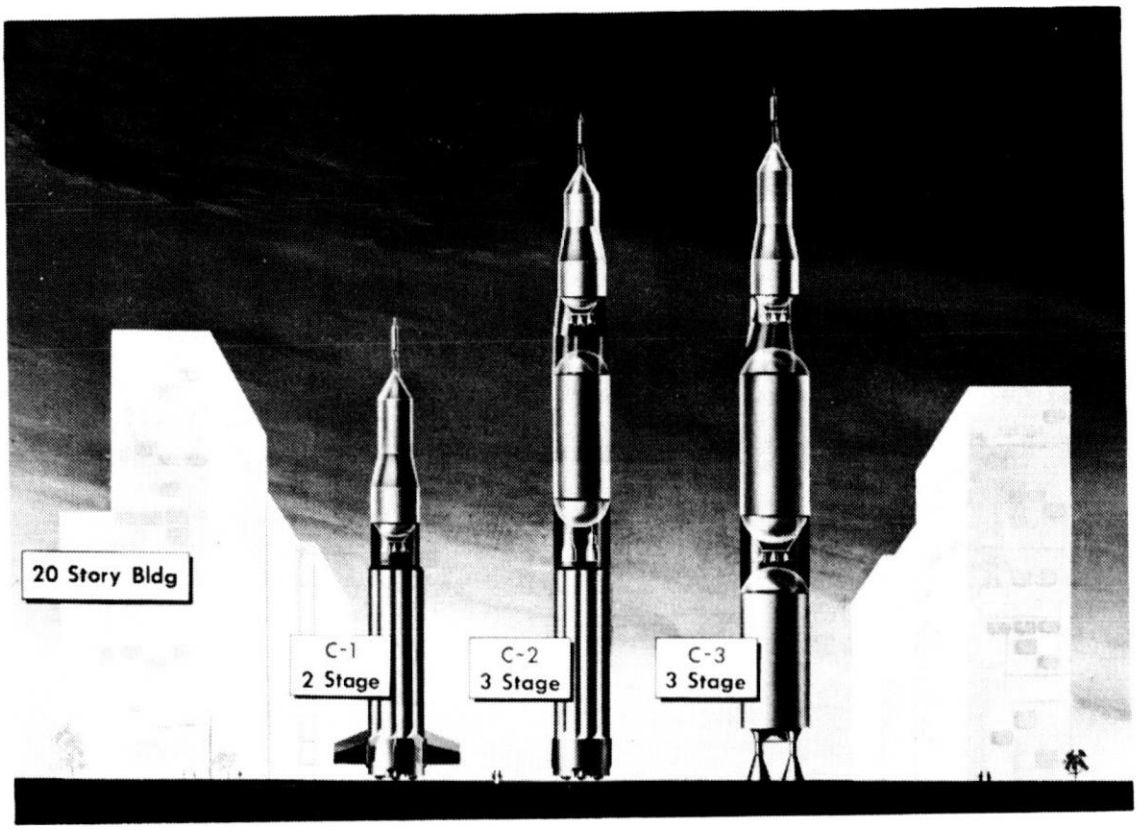
S-I (C-3): The first stage of the C-3 rocket was intended to be powered by two new F-1 engines. This is the rocket the F-1 was first ordered for, not the much later C-5 (Saturn V.). The stage diameter would have been 320 Inches, and the overall length would have been about 113 feet. The Twin F-1 engines would have been on exposed skeletal mounts, the theory at the time being it would reduce the need for "drag-producing" fins by producing the drag with the engine bells themselves. Likely, a production version of this would have ended up almost looking like the much later Pyrios Booster for Space Launch System. The S-I (C-3) stage was also sometimes called S-IB-2. Given that no other S-I stage for the C-3 was ever designed or designated, I choose to ignore the sources that call it S-IB-2 since they all seem to stem from Astronautix.

S-II (C-3) This is the first appearance of the S-II stage for the Saturn Family. Like the S-I (C-3) Stage above, this S-II stage would have been 320 inches in diameter and had 4 J-2 engines. The overall length would have been closer to 70 feet, meaning the S-II (C-3) would have slightly more fuel mass than the latter S-II (C-2 would have.) Again, North American Aviation Documents call this the S-II-320.

S-III (C-3) A short lived stage for the C-3, the S-III here, identical to that of the C-2 rocket, would have served as a waypoint between the S-II (C-3) and the S-IV (C-3.) Canceled as the S-IVB was ordered into creation. On this, the Saturn C-3 rocket, the S-III would have been used for final Orbital insertion in LEO with the S-IV being used for post LEO orbit work only. There is no indication that the "growth" version of the S-IV would have been used with the C-3 rocket. It is assumed that the S-IV pictured above is the correct S-IV for all S-III launches.

S-I (C-3B) Latter in the design process for the Saturn rockets, attention was returned to just the first stage of the Saturn C-3 program and a 33ft (10m) S-I (C-3B) was developed. This would be a 3 F-1 engine powered stage with significant growth of fuel capacity. The remaining stages would be the same as on the C-3 before it. Unlike the Latter S-IC for the Saturn V, the 3 engine C-3B S-I would be approximately 8 meters shorter.

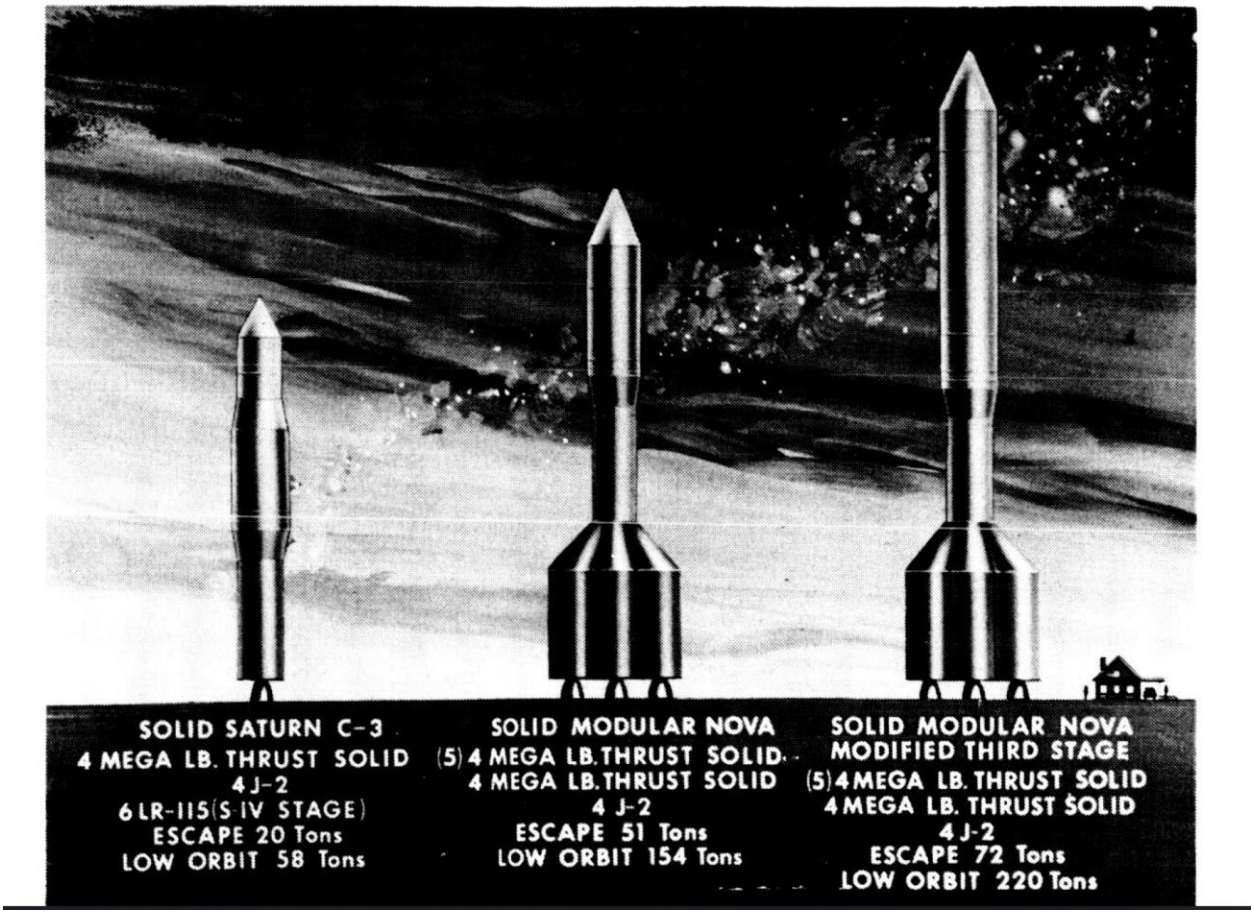
S-N (C-3 or C-3B) In either case of it's first stage the Nerva-powered S-N stage for the C-3 would have had a diameter of 320 inches and an approximate length of 65 feet. Given the secrecy around nuclear reactors, and still today for that matter, there are few realistic drawings of what this stage would look like.



An interesting drawing shows the C-2 with what appears to be a J-2 powered S-II stage and the C-3 with what seems to be an LR-87-powered S-II stage. The C-3 pictured here has non-representative F-1 engines, while all the other engines appear correctly represented. These facts put this graphic as sometime in late 1960 or very early 1961, well before the June 1961 cancelation of C-2. Also, note the C-1 first stage and the C-2 first stage do not show accurate lengths. I believe this is artist bias as it was clearly stated they would be a different length (C-1 first stage longer than C-2 by about 10ft.) Lastly, while it is hard to see, both the C-1 and C-2 only show four engines in their first stage. So, E-1s were still considered at the time the artist drew this.

Solid Saturn:

Solid Rocket fans had a proposal to use a Solid Rocket booster to launch a C-3 rocket. This monolithic SRB would later become the much-loved AJ-260 of Saturn Fame. It would have been in its 4 million pound-force thrust initial long rocket short burn configuration. The one that would break the Saturn INT-05 as mentioned in a previous article. The 2nd stage would still be the larger 320" diameter, so a conic interstage between 260" and 320." One thing noted in several documents is the interstage would have blowout panels in the bottom of the conic structure near the juncture of the AJ-260 and the cone.



And yes, to the observant of you. Nova is stupidly stupid big. And while it uses some of the same engines from Saturn, it is NOT A SATURN! Also, some of the latter MLV proposals for Saturn used some of the engines from NOVA (M-1, anyone?!)

Saturn C series C-4 stages:

The Saturn C-4 was the first design to reach the moon in one launch. It would have had little margin for error, and once Liquid Hydrogen was discovered to not store well in space, this Rocket was thrown out of contention. The switch from Hydrolox to the storable Hypergolic fuel Aerozine50, or 50/50 as most rocket engine engineers called it, dramatically increased the mass at the top of the rocket. The change in fuel makes this rocket nearly moot from the get-go. Two sizes were designed from the start. After Michoud's dimensions were finalized, a 396” diameter quickly supplanted the 320” diameter. When Data is present, I will provide it in 320” and then 396” dimensions. It will be noted if no data is available for one size or the other.

S-I (C-4) 4 F-1 engines, 320” x 113.1ft 396” x 95.01ft.

S-II-320 4x J-2 engines, x69.8ft Length.

S-II-396(C4) 4x J-2 Engines, x 54.98ft Length.

Saturn C-4B: This is a Saturn V in all but name, utilizing a common bulkhead in the S-IC stage.

S-IC (C-4B): 5 F-4 Engines, 396" x 109.77ft Common bulkhead. This stage is approximately 10 feet shorter than the latter flat Bulkhead S-IC for the Saturn V in the MLV programs.

S-II-396: Identical to Saturn V S-II stage.

Several launch configurations did not use the S-IVB and instead used a 396" payload fairing attached directly to the S-II stage.

Oddbal Rockets utilizing the Cluster S-I stage:

Saturn-Atlas: Combining an all-up Atlas F Centaur with the Saturn S-I cluster stage. This idea was removed as silly early in the thought process. Without major changes to the Atlas Launcher, there was no way to secure the Atlas on top of the S-I stage. Also Von Braun did not trust the pressurized "Balloon" tank structures. Part of the Reason is that Centaur C and Centaur E would have a thicker skin wall for the never-built S-V stage.

Saturn-Titan: Separate from the earlier Saturn B series of proposals, a stand-alone, un-modified Titan I would be mounted on the Saturn Cluster stage. The interstage would attach to the Titan's first stage attachment points. The USAF's primary concern was the "cooling" vents on all the early Titan I and II rockets. Something that Martin and Aerojet figured out was not needed two years later when designing the SRM attachment points for the Titan III family.

All in all, these are just SOME of the various odds and ends left collecting dust by the wayside of the development of the Saturn Rocket family.