Before we get into the Titan III family, I feel it is time to mention the unsung hero that made most of the Titan III, and later Titan IV launches successful. The United Aircraft Corporation (later called United Technology), Chemical Systems Division, UA-120x SRM. Yes, that is a mouthful and is generally abbreviated as CSD UA-120x. Of course, since United Aircraft became United Technology in 1975, the UA-XXXX designation was not used on any follow-up SRMs, built or proposed. But WAIT! It gets even more confusing. The Chemical Systems Division was ALSO renamed. So, the United Aircraft/United Technology 156" SRM tested in the late 1960s to early 1970s was actually designated CTD-156x! If you re-shuffle the names around the designation system is the same… just using the new name of Chemical Technology Division of United Technologies…. Sorry if I took you down the rabbit hole there. Designations are important to researching this kind of information. Knowing a little of how something is named makes it much easier to find the information you are looking for.

The UA-120x was a 120" diameter SRM (or 10ft or about 3.05m just like the Titan Rocket!) The designation was from United Aircraft, and while the base UA-1205 is designated SR47-?-x by the USAF, the USAF never ordered any SRMs under the SR47 designation. Likely, this is because the only United Aircraft engine manufacturer listed in the Department of Defense standards was Pratt and Whitney. UA stands for United Aircraft in the CSD designation system, 120 is the diameter in inches, and the x is the number of full-length segments used. It appears that partial segments are ignored because the UA-1207 was ordered for KH-10 Dorian/MOL before the 6.5 segment UA-1206 was for Titan 34D. The UA-120x was tested in 2, 3, 4, 5,6.5, and 7 segments. That corresponds with the designation of UA-1202, UA-1203, UA-1204, UA-1205, UA-1206, and UA-1207. Only the UA-1205, -1206, and -1207 flew on "in service" rockets. A proposed 8 segment version was also mentioned in some documents or the UA-1208. Since the UA-CSD UA-120x was never completely "designated" by the USAF, there is no delineation between what I call the "Generations" of the UA-120x family on any contract. It turns out that there are THREE distinct generations of the UA-120x family, based on physical changes and altered technology, excluding early test prototypes.

Some information for you that will make the generations of UA120x a little easier to identify visually. The SRM's nozzle is fixed on the UA-120x family. Instead of moving said nozzles for control, a very flammable liquid, in this case, a type of "hydraulic fluid", otherwise known as di-nitrogen tetraoxide, or NTO is injected in certain spots around the fixed nozzle, directly into the flame plume of the rocket to generate "thrust vectoring." This alters the center of thrust and the line of thrust in the SRM, without any big, hard to seal, moving parts. It does so by altering the speed of thrust on the side of the SRM the fluid is injected into. These are the big tanks on the side of the SRM. You will notice a pipe feeds from the bottom of these tanks to the bottom segment of the SRM, where the TVC system is. A description of these tanks is included with each generation below. Production UA-120x had either 24 or 32 injection ports around the circumference of the exhaust nozzle. The 32 port injectors is mentioned in only one document and it is on improving the UA1207 between MOL tests and actual Titan IV flights. I believe that the UA-1207 is the only SRM with 32 TVC ports in the nozzle, but the documentation I have only said 'some versions had 32 instead of 24 TVC injection points.'

UA-120x Generation 1: Only the UA-1205 would fly in either the Generation 1 standard or Generation 2 standards. The UA-1207 was to fly on Titan IIIM/ Titan MOL as a Generation 2

SRM, so while it was tested in this configuration, it never flew as such. So back to the generation 1 UA-1205. The TVC fluid tanks on the 1st generation SRMs were un-pressurized, making the tank significantly bigger in diameter and length. It allowed lighter and cheaper metal to be used in their construction, saving mass and cost. The feed for the first-generation tank was gravity + the acceleration of the rocket itself. This combination of ‘downward’ force was used to push the fluid out through the ejectors in the SRM nozzle. This turned out to be a poor choice, and many early Titan IIIC rockets would lose some of their thrust vectoring authority before the end of the UA-1205’s burn cycle. While this did not end up as the cause of failed launches, it was quickly replaced by the 2nd Generation UA-1205.

UA-120x Generation 2: Realizing that the TVC on the UA-1205s already launched was marginal, the CSD division started to make changes to the TVC system before the 5th Titan IIIC flight. The 2nd Generation UA-1205 was built to the just ordered UA-1207’s standard. The UA-1207 was ordered for MOL/KH-10 and these SRMs needed to be man-rated, i.e., have thrust canceling built into them and the ability to ‘put out’ the burning fuel inside. While these thrust canceling features are mostly hidden in the SRM, an obvious indication was on the nose cone in the form of two large closed circular apertures. Through these two apertures, much of the potential thrust of the UA-1205 and UA-1207 would be directed to cancel out the forward thrust from the bottom of the SRMs. While the thrust was neutralized, a “safe” explosive on the sides of the SRM facing away from the core rocket would crack the SRM open, and you have a quick way to put out the SRM. Given the already discovered issues with the 1st Generation’s TVC tanks, CSD replaced them with pressurized ones built and operated like the famous Able upper stage’s pressurized tanks. The new TVC fluid tanks are significantly smaller and are the other key recognition point between the 1st Generation and the latter 2nd and 3rd generation UA-120x SRMs.

UA-120x Generation 3: With the cancellation of the MOL space station, the whole point of the 2nd Generation UA-120x SRM was eradicated. After only a few flights with the Generation 2 UA-1205, the production was switched over to the 3rd Generation. The main difference between the 2nd and 3rd generation lies in the 3rd Generation removed the thrust canceling ports in the nose cone. The side-splitting explosives would fly on every 3rd Generation UA-120x up until the Final Titan IVA flight. Except those side-splitting explosives were now considered “Range safety” instead of “Man Rating” items. IN BDB, we can only build the 2nd Generation UA-120x SRM. The Nose cone section needs to have the circular apertures removed to make it a 3rd generation visually. Now performance-wise, a 2nd Generation UA-1205 and a 3rd Generation UA-1205 are, for all intents, identical. The difference in weight between them is negligible, and the only changes internally are the removal of two explosive rings on the top segment of the SRM. Given in real life, the UA-120x could have it’s thrust curve ‘shaped’ to the mission; the slight changes in mass (150 or so kg) are not enough to mention in any technical documents. A point in fact; the USAF never ordered UA-1205 with any sort of naming, delineation, or calling out of the changes between Gen 1, Gen 2, and Gen 3 SRMs. They were all ordered as JUST UA-1205s. No matter what changes were made to the UA120x family, the thrust curve was altered so that they would perform exactly to specification of the original SRM unless specifically ordered to a new standard. The same is true for the UA-1206 (that was only ever a 3rd Generation SRM) and the more obvious UA-1207. The UA-1207s that were contemplated for MOL were designated no differently than the UA-1207s that flew on Titan IVA. The contracts themselves were different (20 years in age, at a minimum,) but in no public published documents have I been able to find any reference to these generations. There is plenty of photographic evidence. There are comments by the manufacture on the changes through the production lots of the UA-1205 (production lots being what a multi-contract multi-year buy calls the production run contracted in contract X on year Z.) When the USAF would order a new lot of SRMs, any changes to the thrust profile were applied to all of the SRMs in that production lot. This helped to reduce costs. I have found no evidence that the USAF or NASA actually took advantage of "thrust curve shaping," as the manufacture called it beyond maintaining a consistent thrust to weight curve from one iteration to the next as mentioned above.

Lastly, I should mention here; several proposals for UA-120x SRMs to be used as the first stage of a rocket were offered at one time or another. In these cases, the center-most SRMs would not have an angled thrust profile like every UA-120x you have ever seen… but instead would have a nozzle that thrust directly downward. While these never flew, we can consider these UA-120x SRMs almost a 4th generation. Two types of SRMs could have been made. An 'inline' with extra TVC liquid (via a 2nd tank on the SRM.) And an 'inline' SRM with no thrust vectoring capabilities. There would be no TVC tank on the SRM in that case. One Saturn I document that talks about stacking a bunch of UA-1205 or UA-1207s to replace the Cluster stage shows the inner 2 SRMs with no TVC tanks. On a manned rocket, the practicality of this kind of first stage is questionable. Mostly because man-rated SRM would take an excessive number of changes to the SRM pressure vessel. You cannot just blow out two holes in the top anymore… because above the SRM is the S-IVB stage in the case of Saturn, for example. Using the same Saturn Example, you are also flying with 4-9 of the SRMs in that stage… This really complicates the assembly and design of the stage.

I will include the small family of the Titan variants in the next installment designed to fly on one of these 'inline' SRMs for their first stage.