	BN7 一级	S24 二级	Cost in USD 价格(美元)	Ref Index 引用索引	Note 注解
Exploded Rocket Cost **爆炸火箭的费用**					
Dry Mass (metric ton,mt) 干重(公吨)	200	100	N/A	1,2	
Fuel Mass (mt) 燃料重量(公吨)	3,400	1,200	N/A	3,4	
L-OX mass (mt) 液氧重量(公吨)	2661	939	$576,000	5,7	= fuel mass * [lox/ch4 ratio * (lox/ch4 ratio + 1)] = 燃料重量 * [液氧/液化甲烷质量比 * (液氧/液化甲烷质量比 + 1)]
L-CH4 mass (mt) 液化甲烷重量(公吨)	739	261	$130,000	5,8	= fuel mass - lox mass = 燃料重量 - 液氧重量
Raptor 2 Total #/$ 猛禽2发动机数量/总价格	33	6	$29,250,000	11	raptor 2 engine cost includes labor 猛禽2发动机的单价已经包括了人工
Raptor 2 Total Mass (mt) 猛禽2发动机总重量(公吨)	52.8	9.6	N/A	6	= # of engine x each engine weight = 发动机数量 x 发动机质量
Steel Frame Mass (mt) 不锈钢箭体 重量(公吨) / 材料价格	132	81	$639,000	9,10	= (dry mass - total engine mass) x stainless steel mass% = (干重 - 发动机总重) x 不锈钢重量百分比
SN24 Thermal Tile #/$ 二级隔热瓦数量/总价格	0	15,500	$7,750,000	12,13	thermal tile cost includes labor 隔热瓦单价已经包括了人工
Rocket Component Subtotal 箭体部件小计			$38,345,000.00		
Rocket Miscellaneous 箭体其他部件(如电池/天线/阀门/等)			$7,669,000.00	14	= misc % x component subtotal (w/o labor + w/ labor) = 其他部件价格占小计的百分比 x 小计
Rocket Total 火箭总价			$46,014,000.00		= Rocket Component Subtotal + Misc. = 箭体部件小计 + 箭体其他部件
Damaged Launch Facilities That Need Total Replacement **发射场损坏部分需要替换的费用**					
OLM/OLT/Pad Total Cost (w/ Labor) 发射台/塔/产地/其他设备的总成本(包括人工)			$100,000,000	18	
OLM/OLT/Pad Total Material Cost 发射台/塔/产地/其他设备的总材料成本	50%		$50,000,000		50% estimates the material cost vs the total cost 50% 是指材料成本占总成本的百分比。
OLM/OLT/Pad Material Damage Due to OTF Launch 发射场损坏部分需要替换的材料费用的百分比	50%		$25,000,000		50% is % estimate of the total GSE cost that is damaged due to OTF and beyond salvage. Very conservative, in reality, total damage likely less than 50%. 50% 指的是发射场因为发射造成的不可挽回的破坏 占总发射场成本的比例 50%是非常保守的估计，现实里大概率损失要比50%小。
Labor Related to OTF Launch **星舰试飞有关的人工费用**					
Starbase Employee # 2022 2022年星舰基地的员工数	1600			15	
Starbase Employee # 2020 2020年星舰基地的员工数	500			16	
Avg Starbase Employee # 20-22 2020-2022年星舰基地的平均员工数	1050				
Build Engineer Labor % 制造人员占总员工的百分比	70%				70% is a very conservative and overestimated guess for build engineer % 70% 是非常保守的高估的对制造人员占总员工的百分比的猜测。
Build Engineer % on Non-Salvageable Work Related to OTF Launch 因为星舰试飞失败相关的无法再用的制造人员人工的百分比	50%				50% refers to % of the work gone into GSE and vehicle that have been damaged in OTF beyond future use. (think about how starbase buildings, pipes, infra and other BNs and Ss their labor gone into that can and will be reused in the future) 50%指的是有多少人工投入到那些被毁坏而无法再用的发射场设备和火箭 和 总人工的百分比。 (想象一下，星舰基地有多少房子，设备，管道，等等，以及其他已经或正在制造的星舰，那些都是可以在未来使用的)
Build Engineer # 制造人员数量/人工费用	368		$56,672,000	17	= Avg * build enginer % * OTF % = 平均员工数 x 制造人员百分比 x 试飞百分比
Total **总计**			$127,686,000.00		
Ref Index **引用索引**	**Known Stats** **已知数据**	**Value**	**Note / Ref / Citation**		
1	Super Heavy Dry Mass 一级干重(公吨)	200	https://en.wikipedia.org/wiki/SpaceX_Starship (as of 2023/04/25, 快照于2023年4月25日)		
2	Starship Dry Mass 二级干重(公吨)	100	https://en.wikipedia.org/wiki/SpaceX_Starship (as of 2023/04/25, 快照于2023年4月25日)		
3	Super Heavy Fuel Mass 一级燃料重量(公吨)	3400	https://www.spacex.com/vehicles/starship/ (as of 2023/04/25, 快照于2023年4月25日)		

	BN7 一级	S24 二级	Cost in USD 价格(美元)	Ref Index 引用索引	Note 注解
4	Starship Fuel Mass 二级燃料重量(公吨)	1200	https://www.spacex.com/vehicles/starship/ (as of 2023/04/25, 快照于2023年4月25日)		
5	L-OX:L-CH4 mass ratio 液氧和液化甲烷质量比	3.6	https://www.faa.gov/space/stakeholder_engagement/spacex_starship/media/Draft_PEA_for_SpaceX_Starship_Super_Heavy_at_Boca_Chica.pdf p12/第12页:"The Raptor engine is powered by liquid oxygen (LOX) and liquid methane (LCH4) in a 3.6:1 mass ratio, respectively" 液氧和液化甲烷的质量比是3.6比1.		
6	Raptor 2 weight (mt) 猛禽2重量(公吨)	1.6	https://everydayastronaut.com/spacex-raptor-engine-comparison "Raptor 2 is significantly lighter than Raptor 1, with Raptor 1 having a mass of 2,000 kg and Raptor 2 being 1,600 kg" (as of 2023/04/25, 快照于2023年4月25日)		
7	L-OX wholesale $/mt 液氧市场批发价/每吨	$160	https://www.quora.com/How-much-does-NASA-pay-per-kg-for-hydrogen-and-oxygen-in-rocket-fuel (as of 2023/04/25, 快照于2023年4月25日)		
8	L-CH4 wholesale $/mt 液化甲烷市场批发价/每吨	$130	1. mmBTU to ton ratio: 52:1 https://www.hebrewenergy.com/energy-conversion-table-conversion-calculator-energy-calculator-one-bcm-of-natural-gas-one-billion-cubic-meters-of-gas-convert-1-bcm-of-gas-conversion-of-gas/ 2. US wholesale LNG price per mmBTU: $2.5/mmBTU https://www.marketwatch.com/investing/future/ng.1/charts?mod=mw_quote_tab (as of 2023/04/25, 快照于2023年4月25日)		
9	Steel Frame Weight % 不锈钢占箭体干重的百分比	90%	Leaving 10% for all other components, like computer, cable, hydraulic, etc 箭体干重的90%给不锈钢. 其余给其他部件. 像电脑. 电缆. 阀门. 液压. 等等。		
10	30X Stainless Steel $/mt 30X不锈钢价格/每吨	$3,000	https://www.aist.org/AIST/aist/AIST/Publications/Monthly/036-037_November-2022.pdf (as of 2023/04/25, 快照于2023年4月25日)		
11	Raptor 2 $/each (w/ labor) 猛禽2发动机单价(含人工)	$750,000	https://en.wikipedia.org/wiki/SpaceX_Raptor . "In 2019 the (marginal) cost of the engine was stated to be approaching $1 million. SpaceX plans to mass-produce up to 500 Raptor engines per year, each costing less than $250,000" 2019 $1mm/unit, eventually $250k/unit en-masse. Right now estimated to be $750k/unit 2019年. 发动机的边际单价是$1百万美元。最终大规模生产单价预计$25万美元。现在(2023年)保守估计$75万美元		
12	Starship Thermal Tile # 二级隔热瓦数量	15,500	https://www.reddit.com/r/SpaceXLounge/comments/oyrly7/so_i_counted_the_amount_of_tiles_on_starship/ (as of 2023/04/25, 快照于2023年4月25日)		
13	Starship Thermal Tile $/unit 二级隔热瓦单价	$500	https://www.latimes.com/archives/la-xpm-2003-feb-06-sci-tiles6-story.html#:~:text=Today%2C%20there%20are%2024%2C000%20to,to%20make%2C%20NASA%20officials%20said. Space Shuttle Tile $2000/tile, but it's more expensive and better performance than starships. So wild guess of a quarter of price, thus $500. 航天飞机隔热瓦$2千美元每块。但航天飞机隔热瓦的性能要求要比星舰高得多. 因为航天飞机是铝合金材料. 星舰是不锈钢. 耐热程度高得多(翻倍)。 所以根据通常物理/经济定律:结果和输入数值的平方成比. 我的非常不精确的估计是星舰隔热瓦价格是航天飞机的四分之一。		
14	Miscellaneous cost % 火箭其他部件的价格百分比	20%	Just a wild guess 是一个大胆的猜测。		
15	Starbase Employee # 2022 2022年星舰基地的员工数	1600	https://www.houstonchronicle.com/news/houston-texas/space/article/SpaceX-is-our-largest-largest-private-employer-17118164.php (as of 2023/04/25, 快照于2023年4月25日)		
16	Starbase Employee # 2020 2000年星舰基地的员工数	500	https://en.wikipedia.org/wiki/SpaceX_Starbase#:~:text=By%20March%202020%2C%20there%20were,generation%20SpaceX%20launch%20vehicle%2C%20Starship. "By March 2020, there were over 500 people employed at the facility, with most of the work force involved in 24/7 production operations for the third-generation SpaceX launch vehicle, Starship" (as of 2023/04/25, 快照于2023年4月25日)		
17	Startbase Build Engineer Avg Salary 星舰基地的制造员工平均工资	$154,000	https://www.glassdoor.com/Salary/SpaceX-Build-Engineer-Salaries-E40371_D_KO7,21.htm (as of 2023/04/25, 快照于2023年4月25日)		
18	OLM/OLT/Pad 发射台/发射塔/发射场	$100,000,000	https://www.nextbigfuture.com/2023/02/spacex-building-a-third-mechazilla-launch-tower.html (as of 2023/04/25, 快照于2023年4月25日) 这是用最高的估计		