

Open Nuclear Network's

DPRK UNVEILS ITS SOLID-PROPELLANT ICBM MOTOR

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The DPRK claimed to have tested the country's first large and high-thrust solid-propellant motor on 15 December 2022 at the Sohae Satellite Launching Ground. Judging from the stated thrust of 140 tons of force (tf) and purpose,¹ the motor will likely serve as the first stage of a solid-propellant ballistic missile with intercontinental range.²

If the claim is accurate, the test will mark a milestone in the DPRK's efforts to make its intercontinental ballistic missiles (ICBMs) more agile and reliable. The test likely brought the maiden flight of the DPRK's first solid-propellant ICBM a step closer.

The claimed thrust of 140 tf suggests that the motor has higher thrust than typical intercontinental ballistic missiles (ICBMs) from nuclear-weapon States (Table 1). It would also imply that the DPRK's future solid-propellant ICBM will have a heavier mass. Considering that the DPRK's solid-propellant ICBM may have higher structural weight and less efficient propellant, and its warhead may also be heavier than those of nuclear-weapon States, a heavier mass could be an acceptable tradeoff for meeting the required throw weight and range.

	US Minuteman III	Russian RS-12M	Chinese DF-31	Future DPRK solid-propellant ICBM
Lift-off thrust	~102 tf	No authoritative information	~120 tf or lower	Claimed to be 140 tf
Total mass	~36 tons	45.1 tons	~42 tons	~50 tons (using lift-off mass/thrust ratio of Minuteman III as upper end estimate) or higher
First stage casing material	Steel	Reinforced glass fiber plastic	No authoritative information	?

Table 1. Comparison between a potential solid-propellant ICBM by the DPRK and some similar ICBMs of nuclear-weapon States. Sources: US Air Force, The Nuclear Information Project, Military Parade, CSIS Missile Defense Project, China Academy of Launch Vehicle Technology, China Central Television³

¹ The stated purpose is for building a new strategic weapon, see: Respected Comrade Kim Jong Un Guides Important Test of Strategic Significance, KCNA, 16 December 2022, available at:

<http://kcna.kp/en/article/q/5423e068147b92829b052588227b402d.kcmsf>

² Such motors also have the potential to be used for space launch vehicles.

³ US Minuteman: LGM-30G Minuteman III, US Air Force, available at:

<https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104466/lgm-30g-minuteman-iii/>. Minuteman weapon system: history and description, ICBM Prime Team, TRW Systems, July 2001, available at:

<http://www.nukestrat.com/us/afn/Minuteman.pdf>. Russia RS-12M: Russia's Arms Catalog, Volume IV, Strategic Missile Forces, 1996-1997, Moscow: Military Parade. Chinese DF-31: DF-31 (Dong Feng-31 / CSS-10), CSIS Missile Defense Project, 9 August 2021, available at:

<https://missilethreat.csis.org/missile/df-31/#:~:text=The%20missile%20is%20approximately%2015.a%20>

A rough measurement of the motor suggests that the future missile would likely have a diameter of around 2.2 m (Figure 1). This estimate is in alignment with ONN's measurement of an unnamed three-stage submarine launched ballistic missile (SLBM) that was showcased in the April 2022 military parade.⁴

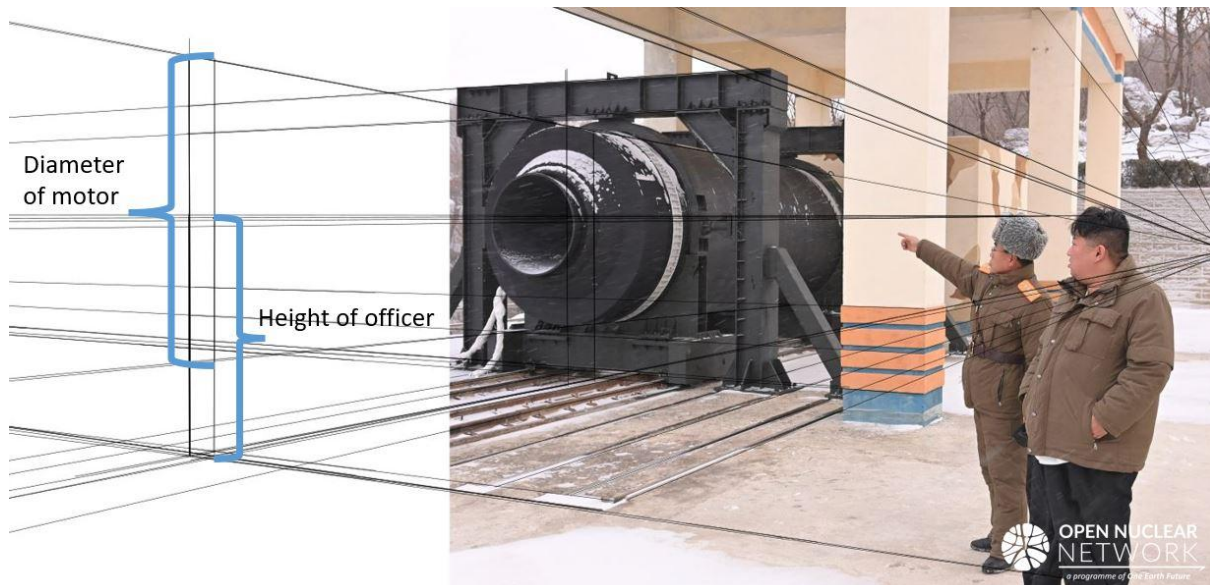


Figure 1. Rough estimate using the assumed height ranging from 1.7 to 1.8 m (hat included) for the military officer standing close to the motor suggests a diameter of around 2.2 m on average, with a margin of error of approximately 10 cm. Image: KCNA⁵

Finally, in order to improve performance, the DPRK may have applied relatively sophisticated vector-control mechanisms, such as gimbaling of the nozzle (Figure 2), to control the flight attitude of its future ICBM. The DPRK has previously applied jet vanes as means for vector control; more sophisticated vector control mechanisms would be more ideal for longer range ballistic missiles.

[20cold%2Dgas%20ejection%20system.&text=The%20DF%2D31%20is%20armed.weighing%20roughly%201%2C050%20%E2%80%93%201%2C750%20kg](#). The thrust estimate is based on the specification of the Long March-11 rocket with a lift-off thrust of 120 tf and a lift-off mass of 58 tons. The Long March-11 is likely based on the DF-31. See: 长征十一号 [Long March-11], China Academy of Launch Vehicle Technology, available at: <http://m.calt.com/n1688/n1702/c13400/content.html>. 长征11号火箭再击苍穹 竟是东风导弹铸剑为犁 [Long March-11, derived from DF missiles, flies again], China Central Television, 20 January 2018, available at: <http://v.cctv.com/2018/01/20/VIDEINLMHu7hA2XO1ZxmJaBs180120.shtml>

⁴ Tianran Xu, Emerging Capabilities? The Unflown SLBMs of the DPRK, Open Nuclear Network, 25 July 2022, available at: <https://opennuclear.org/publication/emerging-capabilities-unflown-slbms-dprk>

⁵ Respected Comrade Kim Jong Un Guides Important Test of Strategic Significance, KCNA, 16 December 2022, available at: <http://kcna.kp/en/article/q/5423e068147b92829b052588227b402d.kcmsf>

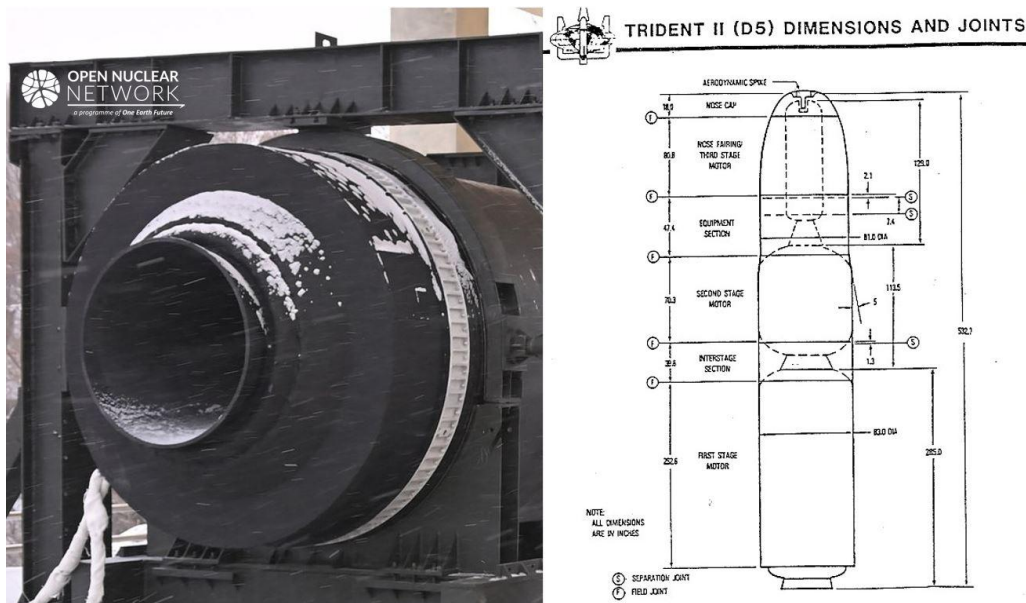


Figure 2. Left: bottom of the motor being tested on 15 December 2022; Right: a simplified line drawing of the US Trident II SLBM. The shape of their bottoms is similar. Images: KCNA⁶, Federation of American Scientists⁷

Developing ground- and sea-based solid-propellant missiles of intercontinental range was one of the “five core tasks of the five-year plan [2021-2025] for building up the national defence capability” established at the 8th Congress.⁸ The 15 December 2022 test re-enforced ONN’s previous assessment that such missiles could be flight tested by the end of 2025.⁹ During the 15 December 2022 test, DPRK leader Kim Jong Un reportedly said that the new strategic weapon shall be developed “in the shortest span of time.”¹⁰ As the time between past initial public motor tests and related ICBM tests has been as short as ten months,¹¹ it is also conceivable that the DPRK will flight-test such a missile as early as in 2023.

⁶ Respected Comrade Kim Jong Un Guides Important Test of Strategic Significance, KCNA, 16 December 2022, available at:

<http://kcna.kp/en/article/q/5423e068147b92829b052588227b402d.kcmsf>

⁷ Trident II D-5 Fleet Ballistic Missile, Federation of American Scientists, available at:

<https://nuke.fas.org/guide/usa/slbm/d-5.htm>

⁸ Report Made by Supreme Leader Kim Jong Un at 8th Congress of WPK, KCNA, 10 January 2021. The DPRK has made progress in fulfilling three other tasks, see: Tianran Xu, Emerging Capabilities? The Unflown SLBMs of the DPRK, Open Nuclear Network, 25 July 2022, available at:

<https://opennuclear.org/publication/emerging-capabilities-unflown-slbms-dprk>

⁹ Tianran Xu, Emerging Capabilities? The Unflown SLBMs of the DPRK, Open Nuclear Network, 25 July 2022, available at: <https://opennuclear.org/publication/emerging-capabilities-unflown-slbms-dprk>

¹⁰ Respected Comrade Kim Jong Un Guides Important Test of Strategic Significance, KCNA, 16 December 2022, available at:

<http://kcna.kp/en/article/q/5423e068147b92829b052588227b402d.kcmsf>

¹¹ The time between the DPRK’s first ICBM test (4 July 2017) and the first publicly-announced test of its engine (19 September 2016) was less than a year.