

Iran's Ballistic Missile Program

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- Iran has the largest and most diverse ballistic missile arsenal in the Middle East. (Israel has more capable ballistic missiles, but fewer in number and type.) Most were acquired from foreign sources, notably North Korea. The Islamic Republic is the only country to develop a 2,000-km missile without first having a nuclear weapons capability.
- Iran is still dependent on foreign suppliers for key ingredients, components and equipment, but it should eventually be able to develop long-range missiles over time, including an Intercontinental Ballistic Missile or ICBM.
- The military utility of Iran's current ballistic missiles is limited because of poor accuracy, so missiles are not likely to be decisive if armed with conventional, chemical or biological warheads. But Tehran could use its missiles as a political or psychological weapon to terrorize an adversary's cities and pressure its government.
- Iran should not be able to reliably strike Western Europe before 2017 or the United States before 2020 – at the earliest.
- Iran's space program, which includes the successful launch of several small, crude satellites into low earth orbit using the *Safir* carrier rocket, proves the country's growing ambitions and technical prowess.

Overview

Iran's pursuit of ballistic missiles pre-dates the Islamic revolution. Ironically, the shah teamed with Israel to develop a short-range system after Washington denied his request for *Lance* missiles. Known as Project Flower, Iran provided the funds and Israel the technology. The monarchy also pursued nuclear technologies, suggesting an interest in a delivery system for nuclear weapons. Both programs collapsed after the revolution.

Under the shah, Iran had the largest air force in the Gulf, including more than 400 combat aircraft. But Iran's deep-strike capability degraded rapidly after the break in ties with the West limited access to spare parts, maintenance, pilot training and advanced armaments. So Tehran turned to missiles to deal with an immediate war-time need after Iraq's 1980 invasion. Iran acquired Soviet-made Scud-Bs, first from Libya, then from Syria and North Korea. It used these 300-km missiles against Iraq from 1985 until the war ended in 1988.

Since the war, Tehran has steadily expanded its missile arsenal. It has also invested heavily in its own industries and infrastructure to lessen dependence on unreliable foreign sources. It is now able to produce its own missiles, although some key components still need to be imported. Iran has demonstrated that it can also significantly expand the range of acquired missiles, as it has done with Nodong missiles from North Korea, which it then renamed. Iran's missiles can already hit any part of the Middle East, including Israel. Over time, Tehran has established the capacity to create missiles to address a full range of strategic objectives.

Iran's expanding arsenal

The Islamic Republic's arsenal now includes several types of short-range and medium-range missiles. Estimates vary on specifics, and Iran has exaggerated its capabilities in the past. But there is widespread consensus that Tehran has acquired and creatively adapted foreign technology to continuously increase the quality and quantity of its arsenal. It has also launched an ambitious space program that works on some of the same technology. The arsenal includes:

Shahab missiles: Since the late 1980s, Iran has purchased additional short- and medium-range missiles from foreign suppliers and adapted them to its strategic needs. The *Shahabs*, Persian for "meteors," were long the core of Iran's program. They use liquid fuel, which involves a time-consuming launch. They include:

The **Shahab-1** is based on the Scud-B. (The Scud series was originally developed by the Soviet Union). It has a range of about 300 kms or 185 miles.

The **Shahab-2** is based on the Scud-C. It has a range of about 500 kms, or 310 miles. In mid-2010, Iran is widely estimated to have between 200 and 300 Shahab-1 and Shahab-2 missiles capable of reaching targets in neighboring countries.

The **Shahab-3** is based on the Nodong, which is a North Korean missile. It has a range of about 900 km or 560 miles. It has a nominal payload of 1,000 kg. A modified version of the Shahab-3, renamed the **Ghadr-1**, began flight tests in 2004. It theoretically extends Iran's reach to about 1,600 km or 1,000 miles, which qualifies as a medium-range missile. But it carries a smaller, 750-kg warhead.

Although the Ghadr-1 was built with key North Korean components, Defense Minister Ali Shamkhani boasted at the time, "Today, by relying on our defense industry capabilities, we have been able to increase our deterrent capacity against the military expansion of our enemies."

Sajjil missiles: Sajjil means "baked clay" in Persian. These are a class of medium-range missiles that use solid fuel, which offer many strategic advantages. They are less

vulnerable to preemption because the launch requires shorter preparation – minutes rather than hours. Iran is the only country to have developed missiles of this range without first having developed nuclear weapons.

This family of missiles centers on the **Sajjil-2**, a domestically produced surface-to-surface missile. It has a medium-range of about 2,000 km or 1,200 miles when carrying a 750-kg warhead. It was test fired in 2008 under the name, Sajjil. The Sajjil-2, which is probably a slightly modified version, began test flights in 2009. This missile would allow Iran to “target any place that threatens Iran,” according to Brig. Gen. Abdollah Araghi, a Revolutionary Guard commander.

The **Sajjil-2**, appears to have encountered technical issues and its full development has slowed. No flight tests have been conducted since 2011. If **Sajjil-2** flight testing resumes, the missile’s performance and reliability could be proven within a year or two. The missile, which is unlikely to become operational before 2017, is the most likely nuclear delivery vehicle – if Iran decides to develop an atomic bomb. But it would need to build a bomb small enough to fit on the top of this missile, which would be a major challenge.

The Sajjil program’s success indicates that Iran’s long-term missile acquisition plans are likely to focus on solid-fuel systems. They are more compact and easier to deploy on mobile launchers. They require less time to prepare for launch, making them less vulnerable to preemption by aircraft or other missile defense systems.

Iran could attempt to use Sajjil technologies to produce a three-stage missile capable of flying 3,700 km or 2,200 miles. But it is unlikely to be developed and actually fielded before 2017.

Space program: Iran’s ambitious space program provides engineers with critical experience developing powerful booster rockets and other skills that could be used in developing longer-range missiles, including ICBMs.

The **Safir**, which means “messenger” or “ambassador” in Persian, is the name of the carrier rocket that launched Iran’s first satellite into space in 2009. It demonstrated a new sophistication in multistage separation and propulsion systems.

The **Simorgh**, which is the Persian name of a benevolent, mythical flying creature, is another carrier rocket to launch satellites. A mock-up was unveiled in 2010. It has a cluster of four engines and indicates that Iran’s space program is making progress in its long-term goals.

Development of larger, more powerful launchers could also provide Iran with an ability to place communication and reconnaissance satellites into orbit, independent of foreign powers.

Factoids

- Iran has invested at least \$1 billion in its missile programs since 2000, according to “Iran's Ballistic Missile Capabilities: A Net Assessment.”
- Iran’s space program aspires to place an astronaut into earth’s orbit. Development of the Simorgh launcher is a key step towards this objective.
- Iran’s universities and other technical centers are conducting basic and applied research in support of the missile and space launcher development programs.

Limitations

Iran’s ballistic missiles have poor accuracy. The successful destruction of a single fixed military target, for example, would probably require Iran to use a significant percentage of its missile inventory. Against large military targets, such as an airfield or seaport, Iran could conduct harassment attacks aimed at disrupting operations or damaging fuel-storage depots. But the missiles would probably be unable to shut down critical military activities. The number of transporter-erector-launchers (TELs) available and the delays to reload them would also limit the impact of even a massive attack.

Without a nuclear warhead, Iran’s ballistic missiles are likely to be more effective as a political tool to intimidate or terrorize an adversary’s urban areas, increasing pressure for resolution or concessions. Such attacks might trigger fear, but the casualties would probably be low – probably less than a few hundred, even if Iran unleashed its entire ballistic missile arsenal and a majority succeeded in penetrating missile defenses.

Iran is also likely to face difficulties if it decides to develop a “second-generation” intermediate-range missile of 4,000 km to 5,000 km, or 2,500 miles to 3,100 miles, using solid-fuel technology. Its engineers would have to design, develop and test a much larger rocket motor. There is little reason to believe that the Islamic Republic could field such a missile before 2018. Moreover, Iran would still have to rely on imported technologies, components and technical assistance, and carry out a lengthy flight-test program.

Finally, Iran’s past missile and space-launcher efforts suggest that Tehran would probably develop and field an intermediate-range missile before trying to develop an intercontinental ballistic missile capable of reaching the United States more than 9,000 km or 5,600 miles away. So an Iranian ICBM seems unlikely before 2020.

Trend Lines

- Although Iran's ballistic missiles are too inaccurate to be militarily effective when armed with conventional warheads, the regime likely believes that the missiles can deter and possibly intimidate its regional adversaries, regardless of warhead type.
- Iran's advanced engineering capabilities and commitment to missile and space launcher programs are likely, over time, to lead to development of additional missile systems. Export controls will slow, but not stop progress.
- There is no strong evidence that Iran is actively developing an intermediate-range or intercontinental ballistic missile. And a new system can't be deployed out of the blue. If Iran decides to pursue an intermediate-range capability, the necessary flight testing will provide a three-to-five year window for developing countermeasures.

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