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Weapons Experts Raise Doubts About Israel's Antimissile System



Uriel Sinai/Getty Images

An interceptor from Israel's Iron Dome antimissile system was fired in November to hit and destroy incoming rockets from Gaza.

By [WILLIAM J. BROAD](#)

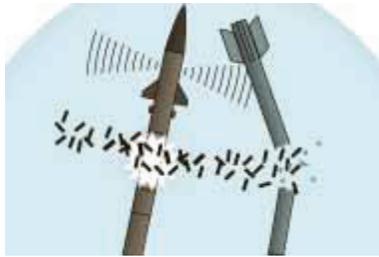
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After President Obama arrived in [Israel](#), his first stop on Wednesday was to inspect an installation of Iron Dome, the antimissile system hailed as a resounding success in the [Gaza](#) conflict in November. The photo op, celebrating a technological wonder built with the help of American dollars, came with considerable symbolism as Mr. Obama sought to showcase support for Israel after years of tensions over Jewish settlements and how to curb [Iran's](#) nuclear ambitions.

Unstated amid the good will, though, was an intensifying debate over whether Iron Dome's feats of warhead destruction were more illusory than real.

Israeli officials initially claimed success rates of up to 90 percent. Michael Oren, Israel's ambassador to the United States, hailed the antimissile system as the first to succeed in combat. Congress recently called the system "very effective" and pledged an additional \$680 million for deployments through 2015.

But a growing chorus of weapons experts in the United States and in Israel say their studies — based largely on analyses of hits and misses captured on video — suggest that Iron Dome destroyed no more than 40 percent of incoming warheads and perhaps far fewer. Many rockets, they argue, were simply crippled or deflected — failures that often let intact or dying rockets fall on populated areas.



Graphic

[Angles of Attack for Israel's Iron Dome Missile System](#)

“They’re smart people,” Richard M. Lloyd, a weapons expert who has written a critique of Iron Dome for engineers and weapons designers, said of the system’s makers in an interview. “But the problems go on and on.”

Behind that skepticism lie the messy realities of combat, as well as a half-century of global antimissile failures. “No military system is 90 percent effective,” said Philip E. Coyle III, who once ran the Pentagon’s weapons-testing program and recently left a White House security post.

For Iron Dome, the performance issue is important, in part, because defense bears strongly on offense. Israel’s decision on whether to bomb Iran’s nuclear sites — as it has repeatedly threatened to do — could hinge on its estimate of the retaliatory costs, including damage inflicted by rockets fired from southern Lebanon and the Gaza Strip.

Iron Dome is the newest and smallest of Israel’s antimissile systems. Its interceptors — just 6 inches wide and 10 feet long — rely on miniature sensors and computerized brains to zero in on its specialty, short-range rockets. Israel’s larger interceptors — the Patriot and Arrow systems — can fly longer distances to go after bigger threats. All have employed explosive warheads to shatter enemy targets, and all have faced doubts about their performance and military value.

Critics say explosions in the sky are hailed as evidence of success when the blasts in most cases simply represent interceptor warheads blowing up.

In an interview, a senior Israeli official denied that explanation, insisting that Iron Dome excelled. Last week, as news of the skeptical analyses spread in Israel, the Defense Ministry issued a statement deploring “baseless claims” that relied on “amateur YouTube videos.” It called the security establishment “more than content with the system’s impressive results.”

The United States contributed an initial \$275 million, and deployments began two years ago. Amid rising anxiety over Iran, the Israeli public saw Iron Dome’s early successes against intermittent fire from Gaza as “a proof that the country could endure” retaliatory strikes, according to Uzi Rubin, founder of Israel’s antimissile program.

The big test came over eight days in November, when Gaza militants fired some 1,500 rockets. As sirens wailed and Israelis ran for cover, the interceptors shot up in waves, exploding in fire and thunder.

Iron Dome commanders fire only when radar systems and computer projections of rocket trajectories show threats to populated areas. Israeli officials say Iron Dome missed 58 incoming rockets while destroying 421. They now put Iron Dome's overall success rate at 84 percent rather than the 90 percent figure.

By all accounts, the interceptor's warhead fires when its sensors indicate an enemy rocket nearby — an encounter zone said to be up to several feet wide. The ensuing blast emits speeding metal fragments that in theory penetrate the rocket's warhead and prompt it to explode.

The system's maker, an Israeli company called [Rafael](#), says in a promotional video that the interceptor is designed "to ensure destruction" of the enemy warhead.

That is precisely the claim critics have challenged.

After the Gaza cease-fire last year, Mr. Lloyd began scrutinizing hundreds of online videos of Iron Dome in action. He was looking for unambiguous signs of success: pairs of fireballs (at night) or smoke clouds (during the day) that formed as speeding fragments blew up a warhead. He found very few, he said.

His method of video analysis won scientific backing long ago. During the 1991 Persian Gulf war, the American military boasted that Patriot interceptors, built in the United States, had succeeded 96 percent of the time. But M.I.T. scientists analyzed broadcast videos and found only misses. Slowly, the Army retreated.

Mr. Lloyd also has the credentials for a critique, having written two books on antimissile warhead design during two decades at Raytheon, a top antimissile contractor. He now works for Tesla Laboratories, a defense contractor that has no projects competing with Iron Dome.

Mr. Lloyd says his doubts about Iron Dome deepened as he saw images of interceptors racing helter-skelter in the sky and found photographs of fallen rockets and even intact warheads.

From such evidence, as well as from rocket and warhead basics, Mr. Lloyd estimates that the system succeeded 30 percent to 40 percent of the time in detonating enemy warheads. For the remaining targets, he judges that the interceptor was either badly aligned or too far away, at best leaving the rockets wounded or thrown off course.

Mr. Lloyd and other critics acknowledge that, in some cases, deflections may indeed lessen damage on the ground, though they lack specific information.

In Israel, Mr. Lloyd won support from Reuven Pedatzur, a military analyst and former fighter pilot long skeptical of his country's antimissile claims. Dr. Pedatzur found an Israeli police report saying that 109 rockets launched from Gaza — roughly twice the military's figure — hit urban areas.

He also found evidence of wide destruction. A Finance Ministry report registered 3,165 claims of property damage, including to cars and buildings in cities like Ashdod and Beersheba, both protected by Iron Dome battalions.

Theodore A. Postol, a physicist at M.I.T. who helped reveal the Patriot antimissile failures of 1991, analyzed the new videos and found that Iron Dome repeatedly failed to hit its targets head-on. He concluded that the many dives, loops and curls of the interceptors resulted in diverse angles of attack that made it nearly impossible to destroy enemy warheads.

“It’s very hard to see how it could be more than 5 or 10 percent,” Dr. Postol said.

Mordechai Shefer, an Israeli rocket scientist formerly with Rafael, Iron Dome’s maker, studied nearly two dozen videos and, in a paper last month, concluded that the kill rate was zero.

American supporters of Iron Dome see the declarations of Israeli officials as credible, in part because the weapon’s targets are relatively slow, small and unsophisticated. “They have no guidance system,” noted Riki Ellison, chairman of the [Missile Defense Advocacy Alliance](#), a private group in Alexandria, Va. “They’re not as accurate as missiles, so Israel doesn’t have to hit them all.”

The senior Israeli official who defended Iron Dome said he understood the skepticism because the world’s first antimissile war — which erupted over Israel in 1991 during the gulf war — did produce exaggerated claims of success. But he rejected the idea that Iron Dome was missing or deflecting most of its targets. The images of online videos, he suggested, lacked the sharpness to reliably see kills within the glowing fireballs.

Enemy warheads, the official stressed, were “destroyed — not engaged — destroyed.” But as the interview unfolded, he offered examples of partial rocket destruction that seemed to contradict the portrayals of total annihilation. Falling debris, he conceded, could sometimes destroy a car or damage a house. But he dismissed reports of wide damage on the ground as rumors.

The Obama administration has cited the videos as testimonials to the system’s importance. “Everybody gets it,” Vice President Joseph R. Biden Jr. recently told the annual meeting of the American Israel Public Affairs Committee, prompting thousands to break into applause. “Everybody saw.”

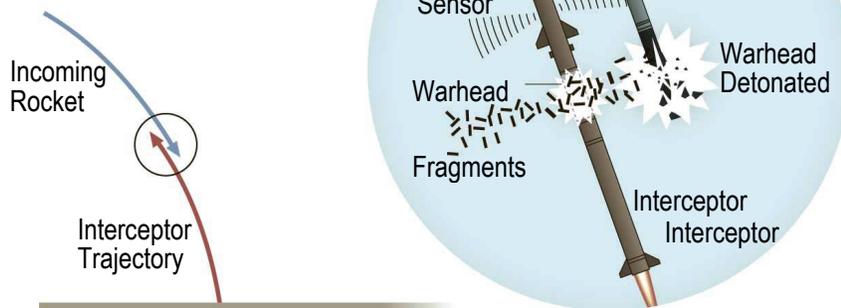
David E. Sanger contributed reporting.

Angles of Attack for Israel's Iron Dome Missile System

Israel last fall hailed the Iron Dome system as destroying hundreds of rockets fired from the Gaza Strip. When an interceptor's sensor detects the incoming rocket, it detonates its own warhead, sending out metal fragments. If the timing is right, fragments will hit the rocket's warhead, detonating it. Skeptics say the Israelis exaggerated the success rate and that the odds of destruction depend critically on how the interceptor approaches the rocket.

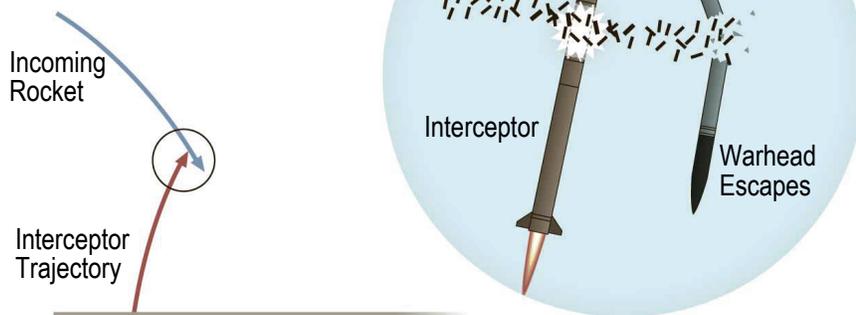
Front Approach

The most effective scenario. The interceptor's warhead is in the best position to have its fragments strike the rocket's warhead and blow it up



Side Approach

Targeting the rocket from the side increases the chance of a miss but the interceptor's blast can still on occasion hit the rocket's warhead



Rear Approach

Chasing the rocket from behind means the metal fragments usually fly before the interceptor can get near the rocket's warhead

