

MISSILES 1969 . . .

intercept targets flying at up to Mach 2. Its standard fragmentation-type warhead can be replaced by a parachute recovery system for training.

USA

Chaparral The 1969 FY budget provided \$97 million for procurement of this close-defence weapon system for the US Army. Cost has been kept to a minimum by basing Chaparral on the well-proven Sidewinder 1C air-to-air missile, adapted for a surface-to-air role. The operator has only to align the fire unit visually on target; after launch the IR missile homes automatically on the enemy aircraft. Normally the four-round launcher will be deployed on a standard US Army M730 tracked vehicle, complete with five-man crew and four spare missiles. It can, however, be trailer mounted or dismounted into a semi-mobile emplacement. Test firings began in mid-1965; production was initiated in April 1966 and a total of 154 Chaparral weapon systems are thought to be covered by current contracts. Eventually, each of the US Army's new 755-man air-defence battalions will have two batteries of Chaparrals and two of 20mm multi-barrel Vulcan guns, with 16 firing elements per battery.

MIM-23A Hawk Best proof of the continued effectiveness of this pioneer low-altitude SAM is that the FY 1969 budget provides \$89 for initial procurement of a new version with larger warhead and improved Aerojet motor using an up-graded polyurethane propellant and sprayed liner to give better propellant-to-case bond. The prime contractor, Raytheon, is also producing a new self-propelled tracked triple launcher which will improve the mobility of the weapon system. Sufficient Hawks to equip 11 JGSDF battalions are being licence built in Japan by Mitsubishi Electric.

MIM-14A Nike Hercules Mitsubishi Heavy Industries have begun licence production of this SAM, which also remains the primary anti-aircraft missile in the USA and with US and NATO forces overseas.

FIM-43 Redeye After a protracted development period, deliveries of this one-man point-defence missile to combat units of the US Army and Marine Corps reached the rate of more than 1,000 a month by the spring of 1968. First overseas customers are Sweden and Australia.

SAM-D This advanced mobile weapon system is intended to provide battlefield defence against both aircraft and missiles in the 1970s and is a potential replacement for Hawk and Nike Hercules. Prime contractor is Raytheon, with solid-propellant motors by Thiokol. SAM-D will utilise a command guidance system with semi-active terminal homing. A single radar will be capable of acquiring, identifying, tracking and directing the interception of several targets simultaneously.

Sea Sparrow The USN Ship Missile Systems Engineering Station is prime contractor for this adaptation of the Sparrow III AAM for close-range air defence of all classes of ships. Test firings have been made successfully from the USS *Enterprise*.

Sentinel Between 15 and 20 launch sites for Spartan and Sprint missiles are expected to be provided in the continental USA under the Sentinel programme. Estimated cost is \$5,000 million and the first sites will be completed in the early '70s, with the object of providing a "thin" anti-ballistic missile defence against ICBMs under development in China. Prime contractor is Western Electric Company, with Bell Telephone Laboratories responsible for system design and development.

Spartan This three-stage nuclear-tipped SAM has been evolved from the earlier Nike Zeus, under the Sentinel programme, to provide a long-range defence against ICBMs. Zeus has achieved many successful interceptions of targets launched by Atlas and Titan missiles. First test firings of Spartan were made successfully in April and May of this year. On the second occasion, the missile was put through a series of dive, climb and turn manoeuvres. Spartan will work either in conjunction with BMEWS or independently, using its own highly advanced acquisition and tracking radars. Range will be several hundred miles, to permit interception of incoming re-entry vehicles above the atmosphere. The entire operation, from detection to destruction, will be automatic with manual override.

Sprint Short-range partner of Spartan in the Sentinel anti-ballistic missile system, Sprint has been under development since 1963 and is now in the advanced test flight phase. Conical in shape, it is popped from its silo launcher by a separate charge. Its own motor ignites when it is clear, to ensure that its acceleration will not have become high enough to impose excessive *g* loading when it is directed on to an interception course. Sprint has the highest acceleration of any US Army missile to provide a "last-ditch" defence if there were insufficient time for Spartan to be launched effectively.

Standard Missile Full production of the two versions of Standard Missile began under a \$120.6 million contract awarded in March 1967 to General Dynamics, which provides the guidance, control and fusing systems. Propulsion and warhead are produced by the Navy Ordnance System Command. The single-stage RIM-66A medium-range Standard Missile and two-stage RIM-67A extended-range Standard Missile are similar in external appearance to the Tartar and Terrier Missiles respectively, which they will replace on about 50 ships. Both versions utilise solid-state electronics and a semi-active homing guidance system.

RIM-8-G-AAW and RGM-8-H-ARM Talos One of the first surface-to-air missiles with interchangeable nuclear and high-explosive warheads, Talos is operational on seven USN cruisers. It can also be used in a surface-to-surface role.

RIM-24 Tartar This medium-range SAM was phased out of production this year. It arms three cruisers and 30 destroyers of the USN, and four French, two Italian, one Japanese and three Australian destroyers.

RIM-2 Advanced Terrier Production of Terrier was also completed this year. The original and advanced versions continue to equip three carriers, six cruisers and 30 frigates of the USN, three cruisers of the Italian Navy and one of the Royal Netherlands Navy.

USSR

Gainful First seen in November 1967, this compact surface-to-air weapon system represents another step in the direction of eventual Soviet capability against low-flying aircraft. It consists of a tracked transporter-launcher, carrying three solid-propellant missiles, each about 19ft 6in long. Gainful has probably not yet entered operational service.

Galosh This missile forms the basis of the "thin" anti-ballistic missile system that is being emplaced around Moscow. Apart from the fact that its first stage has four nozzles, nothing about it in the West, as it has always remained hidden inside its 67ft long, 9ft-diameter trailer-container during Moscow parades. Galosh probably requires extensive ground-support equipment and this is unlikely to be mobile.

Ganef A ramjet sustainer and four solid wrap-round boosters are about all that Ganef has in common with its British counterpart, Bloodhound. First seen in 1964, it is carried on a twin launcher

TABLE 5: AIR-TO-AIR MISSILES

Designation (see notes)	User	Prime Contractor	Dimensions (in)			Launch wt (lb)	Range (n.m.)	Peak alt. (ft)
			Length	Span	Max diam			
Matra R.511	France	SA Engines Matra	121.5	39.5	10.24	397	4	59,000
Matra R.530	France, RAAF, Israel, S. Africa	SA Engines Matra	129.25	43.3	10.24	430	9.5	69,000
Firestreak	RAF, RN, Saudi-Arabia	Hawker Siddeley Dynamics Ltd	125.5	29.4	8.75	300	4.3	n.r.
Red Top	RAF, RN	Hawker Siddeley Dynamics Ltd	137.7	35.7	8.75	n.r.	6	n.r.
AIM-4D Falcon	USAF	Hughes Aircraft Co	79.5	20	6.4	134	n.r.	n.r.
AIM-4E Falcon	USAF, RCAF	Hughes Aircraft Co	86	24	6.6	150	5+	70,000+
AIM-4F Falcon	USAF, RCAF	Hughes Aircraft Co	81	24	6.6	145	5+	50,000+
AIM-26A Falcon	USAF, RCAF	Hughes Aircraft Co	84	20	11	203	5	50,000+
AIM-47A Falcon	USAF	Hughes Aircraft Co	144	36	13	800	n.r.	n.r.
AIM-54A Phoenix	USN	Hughes Aircraft Co	156	36	15	1,000	40+	n.r.
AIR-2A Genie	USAF, RCAF	McDonnell Douglas Corpn	115	24	17.4	820	5	60,000+
AIM-9D Sidewinder IC	USN, UK	Raytheon Co	114	25	5	185	2+	50,000+
AIM-7E Sparrow 111B	USN, USAF, Britain, Italy	Raytheon Co	144	40	8	400	12	60,000+
Atoll	USSR, Poland, Afghanistan, Egypt, Cuba, Finland, Hungary, India, Indonesia, Czechoslovakia, Iraq, E. Germany, Rumania, N. Vietnam, Syria, Yugoslavia	—	110	20.7	4.72	n.r.	n.r.	n.r.

Notes AIM, air-launched interceptor missile; AIR, air-launched interceptor rocket (unguided); IR, infra-red; n.r., not releasable.