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Robert Hewson

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Contents

A PL-5E missile carried by one of the prototype CATIC FC-1 (JF-17) light fighter aircraft (via Robert Hewson) 0558914

Early versions of the PL-5 (PL-5B, PL-5C) are 3.128 m long, with a body diameter of 127 mm, a wing span of 0.657 m, and weight of 87 kg (sources differ on this figure, some quoting a weight in excess of 140 kg). The forward control fins resemble the AIM-9G, with a cropped leading edge at the base of each fin. There are two interchangeable fuze and warhead combinations: an IR fuze and blast/fragmenting warhead or an RF fuze and continuous rod warhead. The improved seeker in this missile was still limited to tail aspect engagements, but has a greater off-boresight capability than the earlier PL-2/PL-3 systems. A PL-5 photographed on display in 1987 carried an AIM-9L-style seeker head and fins, and was labelled as a PL-5B. This was either a sign-writing error or a 'sneak preview' of the PL-5E (or perhaps the notional PL-5D), which did not make its public debut until 1997.

The PL-5E missile shows a shape very similar to the AIM-9L/M with an active laser fuze and an all-aspect engagement capability. This version has a slightly reduced wing span of 0.617 m and also a reduced launch weight of 83 kg. The missile has an operating capability up to 20 km altitude, a peak velocity of M2.5 and a maximum manoeuvrability of 40 g. The minimum range is 500 m. In 2008 data provided by AVIC quoted a slightly extended maximum range of 16 km. The previous official figure had been 14 km. The PL-5E's warhead has a lethal radius of 10 m

First seen in 2008 the PL-5E-II is described by AVIC as an improved third-generation dogfight missile. The missile's weight and dimensions are identical to the PL-5E although the data from CATIC in 2011 indicates that a heavier warhead has been fitted. A laser proximity fuze triggers this 11.5 kg high explosive/fragmentation warhead. A new multi-element, two-colour IR seeker has been added to make the PL-5E-II more resistant to countermeasures and improve its all-aspect capability. The seeker's maximum detection range is quoted as 20 km. The PL-5E-II is also compatible with helmet mounted sight systems. Curiously the maximum aerodynamic load for the PL-5E-II is quoted as 35 *g* compared to 40 *g* for the previous PL-5E.

A 'PL-5B' air-to-air missile, displayed in a PL-5E configuration, seen in 1987 (Raymond Cheung) 0022821

The enhanced PL-5E seeker, showing its new proximity fuse (Robert Hewson) 0137255

A PL-5E missile shown alongside the upgraded PL-9C (Robert Hewson) 0137256

Specifications

	PL-5B	PL-5E	PL-5E-II
Dimensions and weights			
Length			
overall	3.128 m (10 ft 3¼ in)	2.896 m (9 ft 6 in)	2.896 m (9 ft 6 in)
Diameter			
body	127 mm (5.00 in)	127 mm (5.00 in)	127 mm (5.00 in)
Flight control surfaces			
span	0.657 m (2 ft 1¾ in) (wing)	0.617 m (2 ft 0¼ in) (wing)	0.617 m (2 ft 0¼ in) (wing)
Weight			
launch	87 kg (191 lb)	83 kg (182 lb)	83 kg (182 lb)
Performance			
Range			
max	2.7 n miles (5 km; 3.1 miles)	8.6 n miles (16 km; 9.9 miles) (est.)	9.7 n miles (18 km; 11.2 miles)
Ordnance components			
Warhead	6 kg (13.00 lb) HE	9 kg (19.00 lb) HE	11.5 kg (25 lb) HE fragmentation
Fuze	IR	laser (active)	laser (active)
Guidance	IR	IR	IR
Propulsion			
type	solid propellant	solid propellant	solid propellant

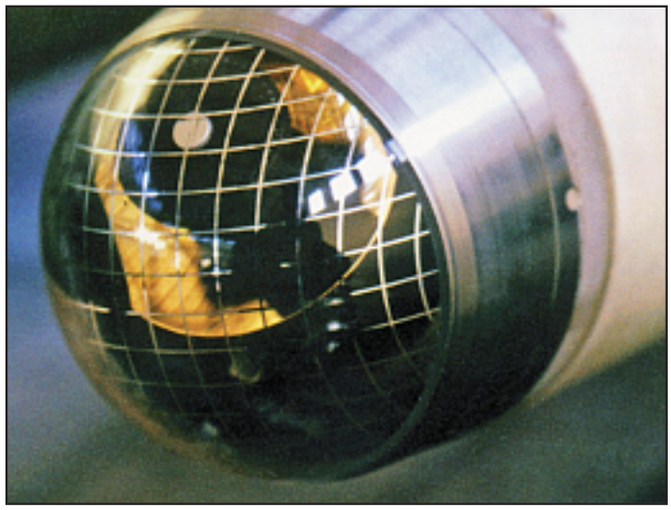
Status

The PL-5 became the basic air-to-air weapon for an earlier generation People's Liberation Arm Air Force (PLAAF) and PLA Navy Aviation aircraft including the Chengdu J-7 (F-7 MiG-21 'Fishbed'), Hongdu Q-5 (A-5 'Fantan') and Shenyang J-8 (F-8 'Finback'). PL-5s are also commonly carried by the Xian JH-7 and enhanced JH-7A strike fighters of the PLAAF and PLAN. The missile has been supplanted by more modern weapons (chiefly the PL-8) on China's newer combat aircraft such as the Chengdu J-10 and Shenyang J-11A. Recently, in parallel with the application of Anglicised designations on many Chinese weapons systems, the designation AKK-5 has been worn by some late-production PL-5 weapons and specifically by a PLAAF variant dubbed AKK-5CK (PL-5CK).

A (possibly single) test firing of the radar-guided PL-5A was recorded in 1982, but this version did not enter Chinese service. The PL-5B was cleared for service with the People's Liberation Army Air Force (PLAAF) in 1986, with the improved PL-5C following at some point in the 1990s. The PL-5E (or PL-5E-II) is now in limited PLAAF service. The export picture for the PL-5 is unclear, and confused by the similarities between it and the PL-2 (and even AIM-9 Sidewinders). PL-5 customers include Albania (all withdrawn), Bangladesh, Burma (Myanmar), Egypt, Iran, Iraq (all withdrawn), Namibia, Nigeria, North Korea, Pakistan, Sri Lanka, Sudan, Tanzania, Venezuela and Zimbabwe.

The PL-5E and PL-5E-II remain important export weapons and appear to be the primary short-range AAMs acquired by Pakistan for its JF-17 Thunder (FC-1) light fighters. Wingtip PL-5Es have been a standard load for the JF-17/FC-1 since it first flew in 2003 and the PL-5E-II was probably developed to be paired with this aircraft in Pakistan Air Force service. Beginning in 2010

A Chengdu F-7G carrying PL-5 AAMs (via Robert Hewson) 1121517



Close-up of the semi-active laser seeker of the Kh-25ML (Tactical Missiles Corporation (TMC)) 1425119

The laser-guided Kh-25ML and anti-radiation homing Kh-25MPU displayed side-by-side (Robert Hewson) 0558915

The command guidance radio antenna for the Kh-25MR is fitted to the missile's tailcone (Christopher F Foss) 0054592

with the now standard 90.6 kg warhead. Maximum speed for the Kh-25MT is 2,900 km/h. The little known **Kh-25MTP** infra-red guided version has a length of 4.15 m. Both Kh-25MT and -25MTP missiles have a minimum range of 2 km, and a maximum range of 20 km. They are powered by the PRD-276 solid rocket motor.

The **Kh-25MP** was a passive homing anti-radiation weapon. It used many design features adopted from the earlier Kh-27 and effectively became the successor to that missile. It was the longest of the Kh-25M series at 4.553 m. It weighed 311 kg with a 90.6 kg warhead.

The **Kh-25MA** active radar guided version has a length of 4.406 m, and a weight increased to 330 kg. This missile has an (approximately) 86 kg HE blast/fragmentation or shaped charge warhead, a minimum range of 2.5 km and a maximum range of 40 km when released from altitude (12 km). The improved **Kh-25MAE** is fitted with the Ka-band (18–40 Ghz) Phazotron-NIIR PSM-E seeker. This weighs 16 kg and has an antenna that can scan through ±30° in azimuth and ±20° in elevation. According to the manufacturer a tank-sized target can be detected at 4 km and a small building at 5 to 8 km. Maximum speed of the missile is 920 m/sec (Mach 2.68).

The latest **Kh-25MS** (export **Kh-25MSE**) version uses satellite navigation, either GPS or GLONASS, coupled with a basic inertial navigation system. This allows for night and adverse weather use against fixed infrastructure or static targets. The Kh-25MS/MSE is 4.355 m log and weighs up to 323 kg with an (approximately) 90 kg high explosive or armour-piercing unit. The Kh-25MSE can be launched at heights from 50 m to 12,000 m. Missile velocity is 920 m/sec (Mach 2.68). Maximum range is 40 km.

Warhead upgrade: At the 2003 Moscow Air Show, the Moscow-based FKP (FKP GkNIPAS) exhibited a new bunker-busting warhead upgrade for the Kh-25ML. This uses an explosively-formed penetrator with a follow-through fragmentation effect designed for use against targets inside shelters and buildings. On impact the penetrating element is formed and is capable of defeating over 1 m of reinforced concrete. The second fragmentation element follows through the breach in the wall and detonates inside the building. FKP GkNIPAS has demonstrated the warhead's effectiveness in a series of rocket sled and air-launched trials conducted from 2001 onwards. By late 2005 state acceptance trials of this new warhead were believed to be underway. By 2007 FKP GkNIPAS had conducted successful sled tests of the new warhead section in live testing against representative infrastructure targets. Since then development work is understood to have been completed, but the production status of the warhead is unclear.

Specifications: *see table below*

Status

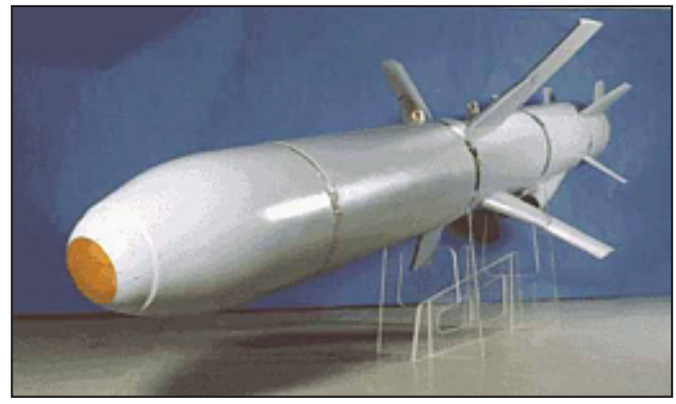
Flight testing of the Kh-25L began in February 1973. Russian sources note a series of 36 tests with a Sukhoi Su-7BM and 12 with the Sukhoi Su-17M. For initial service release the Kh-25L was integrated with the Su-17M2 and acceptance trials began in 1974. The Kh-25 entered service in 1975. By 1976 the missile was cleared for the MiG-23BK (MiG-27K). It was later made available for the Su-24M and Su-25. The improved Kh-25M series entered service from 1981 onwards. The missile family was widely exported to Afghanistan, Algeria, Angola, Azerbaijan, Belarus, Bulgaria, Czech Republic, Georgia, East Germany, Hungary, Kazakhstan, Poland, Romania, Slovakia, Syria, Ukraine, Vietnam and Yugoslavia (Serbia and Montenegro). Most of

Specifications: Kh-25 and Kh-25M (AS-10 'Karen')

	Kh-25R	Kh-25MR	Kh-25MT	Kh-25MTP	Kh-25MA	Kh-25MAE	Kh-25MSE
Dimensions and weights							
Length							
overall	3.8 m (12 ft 5½ in)	3.83 m (12 ft 6¾ in)	4.04 m (13 ft 3 in)	4.15 m (13 ft 7½ in)	4.406 m (14 ft 5½ in)	4.406 m (14 ft 5½ in)	4.355 m (14 ft 3½ in)
Diameter							
body	275 mm (10.83 in)	275 mm (10.83 in)	275 mm (10.83 in)	275 mm (10.83 in)	275 mm (10.83 in)	275 mm (10.83 in)	275 mm (10.83 in)
Flight control surfaces							
span	0.755 m (2 ft 5¾ in) (wing)	0.755 m (2 ft 5¾ in) (wing)	0.755 m (2 ft 5¾ in) (wing)	0.755 m (2 ft 5¾ in) (wing)	0.755 m (2 ft 5¾ in) (wing)	0.755 m (2 ft 5¾ in) (wing)	–
Weight							
launch	310 kg (683 lb)	310 kg (683 lb)	300 kg (661 lb)	300 kg (661 lb)	320 kg (705 lb)	320 kg (705 lb)	323 kg (712 lb)
Performance							
Range							
max	4.3 n miles (8 km; 5.0 miles)	5.4 n miles (10 km; 6.2 miles)	10.8 n miles (20 km; 12.4 miles)	10.8 n miles (20 km; 12.4 miles)	21.6 n miles (40 km; 24.9 miles)	21.6 n miles (40 km; 24.9 miles)	21.6 n miles (40 km; 24.9 miles)
Ordnance components							
Warhead	120 kg (264 lb) HE	90.6 kg (199 lb) HE	90.6 kg (199 lb) HE	90.6 kg (199 lb) HE	90 kg (198 lb) HE	90 kg (198 lb) HE	90 kg (198 lb) HE
Fuze	radar	radar	radar	radar	radar	radar	radar
Guidance	–	–	TV	IR	INS	INS	INS, GPS
					active, radar	active, radar	
Propulsion							
type	solid propellant	solid propellant	solid propellant	solid propellant	solid propellant	solid propellant	solid propellant
For additional variant specifications please see the electronic version of this entry.							

A Have Lite (Popeye 2) missile during US testing, carried by an F-16 (Rafael) 1120836

A view of the Have Lite (Popeye 2), showing the datalink antenna repositioned above the motor nozzle (Peter Humphris) 0092777



The Popeye Turbo (Popeye 3) 0567831

India's Crystal Maze missile is reported to be a derivative of the Popeye 2. Its range is quoted at 80 to 100 km. This missile is credited with an 80 kg warhead, which is significantly smaller than the warheads used by the Popeye 1 or 2. The Crystal Maze may be a further reduced weight variant of the Popeye 2 tailored for the Mirage 2000.

Specifications: *see table below*

Status

Israel and the United States: Popeye 1 entered production in 1989, and is in service with the Israeli Air Force. Initial operational evaluation by the USAF was completed in 1990, following seven successful trials out of eight firings. Delivery of a further 86 missiles and four guidance pods took place in 1990–91. The USAF ordered over 200 AGM-142 'Have Nap' missiles between 1990 and 1995, and the last 30 missiles have IIR seekers replacing the earlier TV systems. The USAF reported that the twentieth AGM-142 flight test was completed in June 1997. A further 205 missiles were ordered in 1998.

The Popeye 2 version entered service in Israel in 1995, for use on its F-16 aircraft. Martin Marietta (now Lockheed Martin) signed an agreement with Rafael for second source production in the US, if the USAF placed additional orders or export orders were received and, in 1997, Precision Guided Systems United States (PGSUS) was formed by Rafael and Lockheed Martin to produce further missiles. It is believed that the USAF placed an order with PGSUS in 1998 for 250 missiles, to be delivered to the USAF and used for export orders. An order was placed by Israel with PGSUS in 1998 for 45 Popeye missiles, followed by a second order for 41 missiles in 2000.

In July 2001 PGSUS was awarded a modification contract to provide for 33 AFB-142F-1 and seven AGM-142F-2 Have Nap Standoff Attack Missiles, 40 short wings/fins/canards, 40 slide-in datalinks, one missile test set, one dummy rocket motor, and associated training, data, spares and warranties. This effort supported foreign military sales to Israel and is to be completed by October 2002.

AGM-142 Deployment: It has been reported that some AGM-142s were delivered by the USAF from B-52 bombers during the 1990–91 Gulf War, and that two were launched unsuccessfully over Kosovo in 1999. USAF flight tests in late 1999, after software changes, proved both TV and IIR guided missiles operated successfully. In a July 2005 interview Major General Robert Chedister, US Air Force Program Executive Officer for weapons and Commander of the USAF's Air Armament's Center noted that the AGM-142 was no longer in the active USAF inventory. The weapon is understood to have been withdrawn from use in 2003.

Export Customers: Export orders were announced in 1996 for 51 AGM-142 Popeye missiles to Australia, for use from its upgraded F-111C aircraft, and to Turkey for integration with upgraded F-4 Phantom aircraft, with 30 Popeye 1 missiles and 120 Popeye 2 missiles to be co-produced in Turkey. Turkey has upgraded 54 F-4Es to Phantom 2020 standard (known as Terminators in Turkish Air Force service). The F-4Es also carry Rafael's Litening III targeting pod. An order for 116 missiles for South Korea for use from its F-4E Phantom and F-16 Fighting Falcon aircraft was announced in 1997.

Australia Integrated the AGM-142E with its F-111C force under the Block Upgrade Programme (BUP). The BUP followed the earlier AUP (Avionics Upgrade Programme) that added new digital systems to the F-111Cs. It had been planned to include AGM-142E capability as part of the AUP but the missile integration work was repeatedly delayed. Australia ordered its AGM-142E missiles in 1996, and at the time planned to declare them operational by 1999. In the event, the first launch trials were not conducted until 2005.

In May 2003 the RAAF's F-111C fleet undertook its first simulated launch of an AGM-142E at the Boeing Aerospace Support Centre, Amberley. The very long-running Australian programme finally saw the first real test of an AGM-142E over the Woomera range facility in July 2005. Two missiles were fired by an F-111. This marked the beginning of the formal test and evaluation programme for the RAAF. An initial operational capability was declared in April 2006 and a full capability followed in 2007. Australia retired its last F-111s on 3 December 2010.

Specifications: Popeye 1, 2 (AGM-142 Have Nap/Have Lite/Raptor)

	AGM-142A	AGM-142A Penetration	Popeye 2	Popeye 2 Penetration
Dimensions and weights				
Length				
overall	4.83 m (15 ft 10¼ in)	4.83 m (15 ft 10¼ in)	4.0 m (13 ft 1½ in)	4.0 m (13 ft 1½ in)
Diameter				
body	533 mm (20.98 in)	533 mm (20.98 in)	533 mm (20.98 in)	533 mm (20.98 in)
Flight control surfaces				
span	1.73 m (5 ft 8 in) (wing)	1.73 m (5 ft 8 in) (wing)	1.73 m (5 ft 8 in) (wing)	1.73 m (5 ft 8 in) (wing)
Weight				
launch	1,360 kg (2,998 lb)	1,360 kg (2,998 lb)	1,130 kg (2,491 lb)	1,130 kg (2,491 lb)
Performance				
Range				
max	43.2 n miles (80 km; 49.7 miles)	43.2 n miles (80 km; 49.7 miles)	40.5 n miles (75 km; 46.6 miles)	40.5 n miles (75 km; 46.6 miles)
Ordnance components				
Warhead	350 kg (771 lb) HE blast fragmentation	352 kg (776 lb) penetration	350 kg (771 lb) HE blast fragmentation	352 kg (776 lb) penetration
Guidance	INS, mid course update, TV, IIR	INS, mid course update, TV, IIR	INS, mid course update, TV, IIR	INS, mid course update, TV, IIR
Propulsion				
type	solid propellant	solid propellant	solid propellant	solid propellant

Specifications: BL EU2, EU3 and EU4 bombs

	BL EU2	BL EU2FR	BL EU2P	BL EU3	BL EU4
Dimensions and weights					
Length					
overall	2.17 m (7 ft 1½ in) (with BS 1 tail)	2.07 m (6 ft 9½ in) (with BSU-86/B tail)	2.24 m (7 ft 4¼ in) (with BS 1 tail)	2.86 m (9 ft 4½ in) (with BS 3 tail)	3.8 m (12 ft 5½ in) (with BS 4 tail)
					3.22 m (10 ft 6¾ in) (with BSU 50/B tail retarder)
Diameter					
body	273 mm (10.75 in)	273 mm (10.75 in)	273 mm (10.75 in)	356 mm (14.02 in)	457 mm (17.99 in)
Flight control surfaces					
tail span	0.38 m (1 ft 3 in)	0.40 m (1 ft 3¾ in) (closed, tail fin)	0.38 m (1 ft 3 in)	–	0.5 m (1 ft 7¾ in) (est.) (with BS 4 tail, tail fin)
					0.94 m (3 ft 1 in) (with BSU 50/B tail retarder, tail fin)
Lug spacing	356 mm	356 mm	356 mm	356 mm	356 mm
Weight					
launch	230 kg (507 lb)	270 kg (595 lb)	232 kg (511 lb)	452 kg (996 lb)	1,000 kg (2,204 lb)
Ordnance components					
filling	HE	HE	HE	203 kg (447 lb) HE	550 kg (1,212 lb) HE

BL EU2FR fragmentation bomb with a US BSU-86B retarding tail unit on the left, and on the right a BL EU2P with a standard BS1 low-drag tail unit (Peter Humphris) 0504927

Two BL EU2 bombs fitted to a Mirage 2000-5 (Peter Humphris) 0051997

bomb by the fitment of a GBU-12 modification kit (Paveway II) or Griffin LGB kit.

The BL EU3 and BL EU4 bombs are of similar construction and differ only in size, weight and destructive capability. Their aerodynamic bodies are constructed from forged steel, and have a flat nose with a standard 2 in fuze well. Both bombs are fitted with 356 mm spaced suspension lugs and can be fitted with a wide range of nose and tail fuzes. The BL EU3, when fitted with the BS 3 ballistic tail unit and without nose fuze, is 2.86 m long, has a body diameter of 356 mm, and an overall weight of 452 kg, of which 203 kg is HE filling. It can be fitted with a wide range of ballistic or retarding tail units. The BL EU4, when fitted with the BS 4 ballistic tail unit and no nose fuze, is 3.8 m long, has a body diameter of 457 mm, a tailspan of about 0.5 m and weighs around 1,000 kg of which 550 kg is HE filling. Like the EU3 it can be fitted with a wide range of ballistic and retarding tail units including the US BSU-50/B retarder. Both bombs are fitted with an integrated arming control system and, in general, their fuzing unit wires are integral within the bomb. The usual nose fuzes used are the FEU 80, FEP 80 and M904E whereas the tail fuzes normally employed are FEU 80, M905E and M906RL. However it is reported that any other standard 2 in fuze could be adapted for use. The BL EU4 could be converted into a laser-guided bomb by the addition of a laser guidance system modification kit.

Specifications: *see table above*

Status

The BL EU2, EU3 and EU 4 series of bombs was developed for and delivered to the French Air Force. There are no details of any exports but the bombs were designed to be fitted with laser guidance kits such as the IAI Griffin. For many years SAMP has had difficulties sustaining production and winning orders. In October 2011 SAMP announced that it was halting all manufacturing at its Pont-sur-Sambre facility. The company said that it would maintain only a small design office and some specialised equipment assets.

Contractor

Société des Ateliers Mécaniques de Pont-sur-Sambre (SAMP).

Durandal (BLU-107/B)

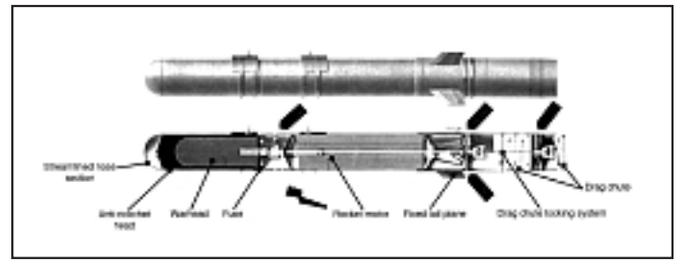
Type

Penetration bomb.

Development

The Durandal bomb was developed in the early to mid-1970s by Matra SA (now MBDA), in collaboration with SAMP to meet a French Air Force requirement for an anti-runway weapon to disable airfields and concrete shelters by low-level attack. The prerequisites for the weapon were the ability to penetrate up to 400 mm of concrete runway or covering and, after doing so, to raise slabs of concrete by exploding at depth. These were met by accelerating the bomb to give it sufficient kinetic energy by means of a rocket motor, an angle of penetration associated with a specially shaped nosecone and a delayed explosion. The experience acquired by Matra in the field of retarded bombs enabled them to develop a dual parachute rapid retarding system and the powerful rocket motor was derived from those used in other missiles. The design of Durandal also incorporated a universal adaptor, which allows the weapon to be attached to all NATO standard 356 mm (14 in) pylons/bomb racks and can, therefore, be carried under the wing or under the fuselage of any NATO fixed-wing low-level attack aircraft.

The USAF tested the Durandal bomb system between 1982 and 1989, and the bomb was given the US designator BLU-107/B. A further development of the same technology was the KRISS submunition fitted to the APACHE stand-off weapon. The Durandal entered production in 1977 and was carried on French Air Force, Mirage F1, and Mirage 2000 aircraft. It was also cleared for



The Durandal penetration bomb 0504477

China's Type 200 anti-runway bomb is clearly based on the Durandal design (via Rob Hewson) 0552946