

# ARCHIVED REPORT

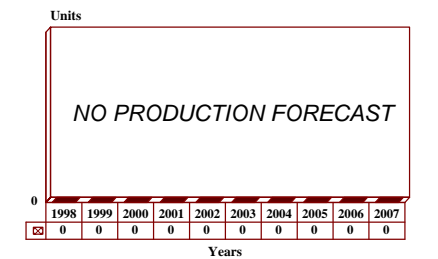
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## Yakovlev Yak-38/141 - Archived 3/99

### Outlook

- No further production is forecast
- The Yak-141 program has been canceled

10 Year Unit Production Forecast  
1998-2007



### Orientation

**Description.** Single- and twin-seat, vertical/short take-off and landing (V/STOL) fighter/interceptor and light anti-ship strike aircraft.

**Sponsor.** The program was sponsored by Yakovlev Design Bureau and the Russian Ministry of Defense.

**Contractors.** Yakovlev Design Bureau; Moscow, Russian Federation.

**Status.** Production of the Yak-38 Forger was ended in 1991. The supersonic Yak-141 Freestyle program has been canceled.

**Total Produced.** Yakovlev has produced approximately 231 Yak-36/38 aircraft, plus four Yak-141 Freestyle

prototypes. The Yak-38 is no longer in active service. Twelve each were previously deployed on the Kiev, Minsk, Novorossiysk, and Baku cruisers. The Yak-38 also was deployed on the Admiral Kuznetsov carrier.

**Application.** Fleet reconnaissance, anti-ship strike, and fleet air defense.

**Price Range.** Yak-38 unit flyaway is estimated at approximately \$18.5 million in 1996 US dollars. The Yak-141 is estimated at \$45-\$47 million if produced in volume and when measured in 1997 US dollars.

### Technical Data

#### (Yak-38/Yak-141)

**Design Features (Yak-38).** Cantilever mid-wing monoplane similar in general appearance to the British Aerospace Harrier and Sea Harrier V/STOL aircraft. The wings have extremely small area and high loading with a leading edge sweep of approximately 45 degrees. The wings fold at about mid-chord for shipboard stowage. The wings have no leading edge control devices; the trailing

edge devices include a single slotted flap and aileron with trim tab. Each wingtip has upper and lower reaction control air jets. The fuselage is basically similar to that of the Harrier with large integral engine inlet ducts. The tail section incorporates a single highly swept vertical stabilizer with single rudder and trim tab. Twin horizontal stabilizers each have a single-piece elevator. The

propulsion layout is much different than the Harrier, with a single large turbojet providing forward power and lift thrust, and twin lift turbojets providing take-off and landing thrust and pitch/trim augmentation. The Tumansky/Soyuz main engine exhausts through twin vectorable nozzles aft of the wings. Twin RKBM liftjets are installed in tandem aft of the cockpit and are angled 13

degrees to provide vertical thrust and to adjust pitch and trim. Aircraft control is fully automated, although there is no use of digital electronics. The airframe is all-metal, including light alloys. Tricycle-type landing gear is employed with single wheels on each unit. The Harrier, by contrast, has bicycle landing gear plus outriggers on each wingtip.

	<u>Metric</u>	<u>US</u>
<b>Dimensions<sup>(a)</sup></b>		
Wingspan	7.32/10.10 m	24.02/33.14 ft
Overall length		
Yak-38 Forger A	15.50 m	50.85 ft
Yak-38 Forger B	17.68 m	58.01 ft
Yak-141	18.30 m	60.04 ft
Height, overall	4.37/5.0 m	14.34/16.40 ft
<b>Weights<sup>(b)</sup></b>		
Maximum take-off		
Yak-38	11,700 kg	25,795 lb
Yak-141 (VTOL)	15,800 kg	34,830 lb
Yak-141 (STOL)	19,500 kg	42,990 lb
Empty (Yak-141)	11,650 kg	25,685 lb
Basic operating weight (incl. crew)		
Yak-38 Forger A	7,485 kg	16,500 lb
Yak-38 Forger B	8,390 kg	18,500 lb
<b>Performance<sup>(c)</sup></b>		
Maximum level speed at height	1,009/1,800 km/h	545/970 kt
Service ceiling	12,000/15,000 m	39,375/49,200 ft
Rate of climb at SL		
Yak-38	4,500 m/min	14,750 ft/min
Range (STOL) at SL		
Yak-141 <sup>(d)</sup>	1,010 km	545 nm
<b>Propulsion</b>		
Yak-36/38	(1) Tumansky/Soyuz R-27V-300 axial flow cruise turbojet engine rated at 59.8 kN (13,450 lbst), and	
	(2) RKBM RD-36-35FVR axial flow lift-type turbojets rated at 30.4 kN (6,835 lbst) each.	
Yak-141	(1) Soyuz RD-79V-300 turbofan rated at 152.0 kN (34,170 lbst) with afterburner and 88.3 kN (19,840 lbst) dry, and	
	(2) RKBM RRD-41 lift turbojets rated at 40.2 kN (9,040 lbst) each.	

**Armament.** Yak-38: Two underwing pylons with a total capacity of 2,000 kilograms (4,410 pounds). External stores carried included a 23 mm gun pod, rocket packs, 500-kilogram conventional gravity bombs, air-to-surface missiles, anti-ship missiles, air-to-air missiles, and external fuel tanks. No internal gun.

Yak-141: External weapons load of 2,600 kilograms. One integral 30 mm gun.

**Crew.** Yak-38 Forger A: Single pilot on zero-zero ejection seat. Yak-38 Forger B: Student and pilot in tandem on ejection seats within extended nose. Yak-141: Single-seat and twin-seat variants were under development.

<sup>(a)</sup> Yak-38 data are estimated.

<sup>(b)</sup> Yak-38 data are estimated.

<sup>(c)</sup> Yak-38 data are estimated and refer to Forger A at maximum takeoff weight.

<sup>(d)</sup> With weapons load of 1,000 kilograms (2,205 pounds).

## Variants/Upgrades

Yak-36 Freehand. Demonstrator aircraft and predecessor of Yak-36M.

Yak-36M. Designation of Yak-38 prototype. First flew in 1971.

Yak-38 Forger A. Single-seat model. Production commenced in 1975.

Yak-38M Forger A. Improved version of the basic Yak-38. Single-seater. The main engine is a Tumansky/Soyuz R-28V-300 turbojet rated at 65.7 kN (14,770 lbf). RKBM liftjets are each uprated to 31.9 kN (7,165 lbf).

Yak-38 Forger B. Two-seat version with extended cockpit and a fuselage plug aft of the cockpit to compensate for the extra length.

Yak-141 Freestyle. Yakovlev began development of this derivative supersonic V/STOL light attack aircraft/interceptor in 1975. The aircraft has an entirely new airframe with twin vertical tails, and a multimode

fire control radar. Propulsion configuration is the same as for the Forger: lift/cruise plus lift. The aircraft has a fly-by-wire flight control system and an airframe constructed primarily of aluminum-lithium alloys but with approximately 26 percent in carbon-based composite materials. It is also equipped with a Zvezda K-36 ejection seat, a head-up display, multifunction displays, and an IFF system. The aircraft has an integral 30 mm gun. It can carry up to 2,600 kilograms of ordnance and missiles on four weapons pylons. Maximum level speed at height is around Mach 1.7, with agility somewhat less than the MiG-29. Russian Defense Ministry funding for the program was terminated in 1991. Also in 1991, one of the prototypes crashed during deck trials. The Yak-141 was seen as a replacement for the Forger on ex-Soviet Navy through-deck cruisers: the Kiev, the Minsk, the Novorossiysk, and the Baku. Although Yakovlev continued some development work on the Yak-141 beyond the termination of Defense Ministry funding, the program has now been canceled.

## Program Review

**Background.** Until its retirement from service, the Yak-38 Forger had been one of only two operational V/STOL fighter aircraft in the world: the other being, of course, the British Aerospace/McDonnell Douglas Harrier family. Development began in the mid-1960s and coincided with several V/STOL research and development projects then ongoing in the West, including the Harrier. However, where all but the Harrier were terminated for performance shortfalls, the Forger's design was completed. It featured a propulsion configuration completely different from that of the

Harrier. The Forger has a single cruise engine and twin liftjets.

**Mission.** All Yak-38 aircraft have been withdrawn from service. They were previously deployed on the Kiev, Minsk, Novorossiysk, and Baku cruisers and the Admiral Kuznetsov carrier of the Russian Navy. The Forgers provided carrier air cover and light anti-ship duties. Their limited range and weapons payload have rendered them essentially useless against most advanced naval air threats.

## Funding

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Russian Defense Ministry funding for the Yak-141 program was terminated in 1991. The program then continued solely under the auspices of the Yakovlev Design Bureau itself; however, it has since been canceled.

## Recent Contracts

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None.

## Timetable

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Mid-	1960s	Soviet Union began studies of V/STOL aircraft
	1971	First flight of Yak-38 prototype (Yak-36M)
	1975	Production began
	1975	Yak-141 design effort launched
	1976	Yak-38 deployment aboard Kiev-class cruisers began
Mar	1989	First flight of Yak-141 prototype
Oct	1991	Yak-141 prototype crashed
	1991	Forger production terminated

## Worldwide Distribution

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All Russian Navy Yak-38s have been withdrawn from service. No other country has Yak-38s in its inventory.

## Forecast Rationale

With limited range and very limited payload, the Yak-38 Forger is essentially useless in all but a few attack scenarios and is even more limited in air-to-air engagements because of the lift-cruise engine combination's inability to provide the maximum of thrust vectoring during combat maneuvering. The Harrier I and the Harrier II have no such difficulties. The Yak-141, while superior to its Forger predecessor and possessing supersonic capability, is still not comparable to the AV-8B, particularly in its payload capability.

Yak-38 production ceased in 1991 and the Yak-141 was supposed to replace it on the production line. However, the Yak-141 program experienced financing difficulties throughout its history, and the Russian Defense Ministry terminated funding of the program in 1991. Even had the Russian military stayed with the program, there may not have been a domestic market for the aircraft. The four-ship Kiev class of cruiser/carriers, which were to embark the Yak-141 as a Forger replacement, had dropped to just one ship by 1995. Meanwhile, the chances of getting the Yak-141 aboard

the Kuznetsov class of conventional takeoff and landing carriers were never very good, since overall performance and payload were not in the Su-27 and MiG-29 classes and certainly not sufficient to protect expensive naval assets such as the Kuznetsov carriers.

Yakovlev continued some Yak-141 development work beyond 1991, but without the participation of the Russian Defense Ministry. The company sought international partners for co-development of the aircraft. The Indian firm HAL was seen as one potential partner. Several companies showed interest in participating in production of the aircraft. Meanwhile, Yakovlev was designing ways to upgrade the Yak-141, with research efforts examining increasing engine thrust, improving the airframe design, updating fire control systems, and expanding aircraft weaponry. However, the Yak-141 program was eventually canceled.

No additional Yak-38s or new Yak-141s are forecast. The Yak-141 program is unlikely to be revived and enter production. Financial difficulties make a Yak-141 acquisition by the Russian Navy and/or Air Force unlikely.

## Ten-Year Outlook

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No forecast.

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