SOVIET SPYPLANES OF THE COLD WAR

Yefim Gordon
and Dmitriy Komissarov

FlightCraft 1

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Above: A fine study of MiG-25RBK '55 Red' on final approach.

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Introduction

One of military aviation's first specialisations was 'Spy in the Sky'. The advent of fighters during the First World War rendered the use of tethered balloons and airships for reconnaissance/battlefield observation too risky. The answer was a new class of aircraft – scout aircraft in which the second crewmember, in addition to his main duties as a gunner, would photograph objectives in the enemy's rear area, such as airfields and garrisons. Safety from enemy attacks (and thus mission success) was ensured both by the defensive armament and by the aircraft's speed and altitude performance. The latter two became the main parameters for reconnaissance aircraft in the Second World War.

With the beginning of the jet age the speed and service ceiling of combat aircraft improved appreciably. For reconnaissance aircraft, however, altitude performance was of greater importance than speed because high-speed interceptors guided by ground-based air defence radars could easily catch up with the target and destroy it – which they found harder to do at high altitudes. A high-flying spyplane with high aspect ratio wings was harder to detect and engage, since interceptors tailored for high speeds usually had swept or delta wings that did not allow them to climb that high. The interceptor's armament, which added weight (and, in the case of air-to-air missiles, also added drag), was another limiting factor here.

After the Second World War the USA was the nation that attached the greatest importance to aerial espionage, launching the Peacetime Aerial Reconnaissance Program (PARPRO) targeted against the Soviet Union. This led to the development of such high-performance spyplanes as the Boeing RB-47 Stratojet, Martin RB-57, and later the famous Lockheed U-2 and the equally famous Lockheed SR-71 Blackbird. Later, when mankind started exploring outer space, this, too, became an arena for espionage activities, surveillance satellites being developed and placed into orbit. As for aerial reconnaissance, it was largely reoriented from photo reconnaissance (PHOTINT) to electronic intelligence (ELINT). The highly specialised sensitive equipment on board a 'ferret aircraft' allowed it to detect and identify enemy emitters (radars and the like), eavesdrop on enemy communications and even obtain high-resolution electronic imagery in real time.

The Soviet Union, too, developed and fielded a whole range of reconnaissance aircraft in the post-war years; yet these were not 'true' spyplanes, being intended for tactical tasks, not strategic ones. In the mid-1950s the Soviet Air Force did possess a small number of aircraft that qualify as spyplanes in the traditional meaning of the word – the Yakovlev Yak-25RV specialised high-altitude reconnaissance aircraft, the first of the kind in the Soviet Union. Unfortunately its career proved to be very brief and, unlike its US counterpart (the U-2), next to nothing is known about its operational use – both because of the small production run and because many archive documents are still classified.

In the 1960s, however, the Soviet 'fighter maker' Mikoyan developed the famous (and very capable) MiG-25 high-speed aircraft which had a number of reconnaissance variants. The story of the MiG-25R *et seq.* is much longer (even today the type is in service with the Russian Air Force) and much better known. Its capabilities and the missions it has performed over the years mean the MiG-25R qualifies as a true spyplane. Later the Soviet Union fielded a number of other ELINT aircraft. Yet for reasons of space this book deals only with the two abovementioned types.

MiG-25s at Neu-Welzow AB, Germany, in 1991 or 1992. MiG-25RBS '52 Red' is nearest, followed by MiG-25RBT '54 Red'. '75 Red' in the background is a MiG-25BM suppression of enemy air defences (SEAD) aircraft.

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'Soviet U-2'

The Yakovlev Yak-25RV

As early as 1951 the Moscow-based OKB-115 design bureau led by Aleksandr S. Yakovlev (***op****ytno-kon****strook****torskoye byu****ro*** – experimental design bureau) began development of an all-new patrol interceptor at its own risk. Such an interceptor with long endurance was desperately needed for defending the Soviet Union's Far East and High North regions where it would be difficult to set up a system of surface-to-air missile (SAM) sites. Bearing the in-house designation Yak-120, the aircraft was a two-seater (the crew consisted of the pilot and a radar intercept officer). It was a mid-wing monoplane with thin wings were swept back 45° and sharply swept cruciform tail surfaces. The powerplant consisted of two 2,000-kgp (4,410-lbst) Mikulin AM-5 axial-flow non-afterburning turbojets mounted in slender nacelles adhering directly to the wing undersurface. The chosen layout dictated the use of a bicycle undercarriage with wingtip-mounted outrigger struts. The interceptor featured the new and promising RP-6 ***Sok****ol* (Falcon) radar in a large parabolic nose radome and was armed with two 37-mm (1.45 calibre) cannons.

On 19th June 1952 the Yak-120 performed its maiden flight. The manufacturer's flight tests proceeded until November. While admittedly heavier than single-engined air superiority fighters of the day, the aircraft was smaller and lighter than its Mikoyan and Lavochkin competitors (the I-320 and La-200). Moreover, the Yak-120 surpassed the Air Force's specific operational requirement in all respects except range and endurance, which fell a little short of the requirements; even so, the aircraft was able to patrol an assigned area at a considerable distance from its home base. However, development of the Sokol radar was taking longer than predicted, and as the radar was unavailable the Yak-120 could not be submitted for State acceptance (= certification) trials. Hence in early December 1952 it was decided to fit the prototype with the less capable RP-1 *Izum****rood*** (Emerald) radar as a stop-gap measure. From March to June 1953 the Yak-120 was tested with the provisional radar installation at the State Air Force Research Institute awarded the Red Banner Order (GK NII VVS – *Gosu****dars****tvennyy Krasnozna****myon****nyy na****ooch****no-is****sle****dovatel'skiy insti****toot*** *Vo****yen****no-voz****doosh****nykh seel*). Even though the State commission did note a few shortcomings, the general opinion was favourable and the aircraft was recommended for production under the service designation Yak-25. Production took place at aircraft factory No. 292 in Saratov in southern Russia, which turned out the first production interceptors in September 1954. Very few were built with the Izumrood radar. By the end of 1953 the RP-6 was finally brought up to scratch; in April 1954 the Yak-120 prototype successfully completed its trials, and at the end of the year the initial version was superseded in production by the Yak-25M (*modi-fi****tsee****rovannyy* – modified) featuring the new radar. The Yak-25 entered first-line service in 1954, followed shortly by the Yak-25M. Both varieties were allocated the NATO reporting name *Flashlight-A*.

The same directive of the Soviet Council of Ministers (i.e., government) and Communist Party Central Committee dated 10th August 1951 which formally launched the Yak-120 tasked OKB-115 with developing a photo reconnaissance version. The first attempts proved abortive – the Yak-25R ([*samo****lyot***-] *raz****ved****chik*, reconnaissance aircraft) and Yak-25MR never entered production, as they were already obsolete by the time they were tested. Yet, three years after its service entry the Yak-25 evolved into a very different aircraft – the Soviet Union's answer to the Lockheed U-2. In 1957-58 the Yakovlev OKB developed a strategic reconnaissance aircraft designated **Yak-25RV** (*raz****ved****chik, vy****sot****nyy* – reconnaissance aircraft, high-altitude). Some early documents referred to the aircraft simply as 'Yak-RV'.

The Yak-25RV programme was officially launched by Council of Ministers/CPSU Central Committee directive No. 419-198 dated 16th April 1958. This specified a service ceiling of 20,000-21,000 m (65,620-68,900 ft), a maximum speed of 900 km/h (559 mph) at 15,000 m (49,210 ft) and 800 km/h (496 mph) at 20,000 m, a minimum speed of 750 km/h (465 mph) at 20,000 m, a range of 2,500 km (1,550 miles) at 20,000 m, 3,500 km (2,174 miles) at 16,000-18,000 m (52,490-59,055 ft) and 5,000 km (3,105 miles) at 13,000-14,000 m (42,650-45,930 ft).

Structurally the aircraft had very little in common with the original interceptor. Firstly, wing loading had to be reduced considerably to ensure good high-altitude performance. Hence the wings were all-new; they were unswept, with more than twice the span – 23.5 m (77 ft 1 13/64 in) versus 11.0 m

Opposite page:

The progenitor of the *Mandrake* – the Yak-25M *Flashlight-A* interceptor. The swept wings of relatively short span with boundary layer fences are readily apparent.

This view of the Yak-25M shows the AM-5 engines, the large nose radome, the two-seat cockpit and the twin cannons located low on the centre fuselage sides.

(36 ft 1¾ in) for the Yak-25/Yak-25M, an area of 55 m² (591.39 sq ft) versus 28.96 m² (311.39 sq ft) and an aspect ratio of about 10. As a result, wing loading decreased from 310 kg/m² (63.55 lb/sq ft) to a mere 175-178 kg/m² (35.87-36.49 lb/sq ft) – less than that of the Second World War-vintage Yak-3 fighter!

Secondly, the thrust/weight ratio was improved dramatically by using a new power-plant. The interceptor's 2,000-kgp (4,410-lbst) Mikulin RD-5A (AM-5A) turbojets gave way to Tumanskiy R11V-300 turbojets – a special non-afterburning high-altitude version of the R11F-300 engine powering the Mikoyan MiG-21F *Fishbed-C* light fighter (once again, the V stood for *vy**sot**nyy* – high-altitude). The R11V-300 delivered twice the power of the RD-5A – 4,000 kgp (8,820 lbst) at full military power and 3,250 kgp (7,165 lbst) at nominal power. The new engines required the nacelles to be designed from scratch.

Above: '75 Yellow', the first prototype Yak-25RV reconnaissance aircraft. This aspect shows clearly the high aspect ratio unswept wings with no fences, the 'solid' metal nose tipped by a pitot boom, the single-seat cockpit and the new R11V-300 engines in redesigned nacelles.

The forward fuselage was new, featuring a single-seat cockpit and a reshaped all-metal nosecone housing avionics and equipment; a vertical camera was housed in the rear fuselage. The tail unit was also redesigned, with slightly increased leading-edge sweep, a larger fin fillet and a variable-incidence tailplane. Changes were made to the landing gear: the outrigger struts retracted forward, not aft, and because of the narrow tip chord the wingtip fairings housing them appeared disproportionately large. The twin wingtip pitots were replaced by a single nose pitot. Finally, the Yak-25RV was unarmed, albeit the said directive had stipulated a single Nudelman/Rikhter NR-23 cannon with 50 rounds. (The idea had been to develop a version optimised for intercepting high-flying drifting reconnaissance balloons – the stillborn Yak-25PA.)

Prototype construction was completed in early 1959. Coded '75 Yellow', the aircraft entered flight test on 1st March 1959 (about three months later than anticipated) with project test pilot Vladimir P. Smirnov at the controls. Test pilot Aleksey A. Shcherbakov of the Flight Research Institute named after Mikhail M. Gromov (LII – ***Lyot****no-is****sle-d****ovatel'skiy insti****toot***) also flew the aircraft. The test programme was completed successfully on 29th May 1959. The prototype's empty weight was 6,175 kg (13,613 lb) and

all-up weight was 9,800 kg (21,605 lb). During trials the Yak-25RV attained a maximum altitude of 21,000 m (68,900 ft) and a top speed of Mach 0.82, which was considered adequate for a high-altitude reconnaissance aircraft.

Smirnov reported that the Yak-25RV's handling was broadly similar to other jets at up to 11,000 m (36,090 ft) and climbing to 18,500-19,500 m (60,695-63,980 ft) presented no problems. Above that, however, the pilot had to exercise special care because the Yak-25RV's speed envelope was extremely narrow – the never-exceed speed (V_{NE}) was just 10 km/h (6.2 mph) above the stalling speed because of the rarefied air at high altitude. This put constant pressure on the pilots; as service pilots converting to the Yak-25RV from the Sukhoi Su-9 *Fishpot-B* interceptor put it, 'you have to keep your ears pricked!' Thankfully the aircraft gave ample warning that the limit was near; at minimum control speed it would start swaying from side to side with increasing amplitude, and at V_{NE} it would start vibrating noisily.

The service ceiling could not be determined because the engines tended to flame out at 19,600-20,100 m (64,300-65,940 ft) and there was no oxygen feed system to facilitate restarting, which meant the aircraft had to descend to 6,000 m (19,680 ft) before a restart became possible. The pilot had to wear a special SI-3M pressure suit which also drew some criticism – it was cumbersome like a diver's suit and tended to inflate, hampering the pilot's actions.

A curious feature of the Yak-25RV was its reluctance to descend from high altitude. In one of the test flights, when Smirnov had reached maximum altitude, he discovered that the aircraft was firmly intent on staying up there; only when the landing gear was extended did the prototype start descending slowly. Later, Shcherbakov had a similar experience. In his test report he suggested that the Yakovlev OKB incorporate some device reducing the aircraft's lift/drag ratio in order to facilitate descent (the Yak-25RV lacked the interceptor's lateral airbrakes). One more peculiarity of the Yak-25RV was its extremely flat glideslope on landing as compared to contemporary jets.

Upon completion of the manufacturer's flight tests the Yak-25RV was prepared for an attempt on the world altitude record. On 13th July 1954 Vladimir P. Smirnov reached 20,456 m (67,112 ft) with a 1,000-kg (2,204-lb) payload; sixteen days later he set a second record by reaching 20,174 m (66,187 ft) with a 2,000-kg (4,409-lb) payload. In the *Fédération Aéronautique Internationale* (FAI) papers acknowledging the records the aircraft type was stated simply as 'RV', which caused some Western analysts to decipher this abbreviation erroneously as *re**kord** vyso**ty*** (altitude record) – probably by analogy with the Tupolev ANT-25 record-breaking aircraft of 1930s fame, which was known as RD (*re**kord dahl'**nosti* – range record). It should be noted here that, reluctant to reveal the true identity of combat aircraft setting various world records, the Soviet aviation authorities would often furnish bogus aircraft and engine designations for the FAI documents. Thus, a specially-modified Sukhoi Su-27P *Flanker-B* interceptor used to set a number of time-to-height and altitude records in 1986-87 was entered as the P-42, while its Lyul'ka AL-31F afterburning turbofans were reported as 'R-32 jet engines'. In the case of the Yak-25RV this, of course, was a coincidence both the FAI and the USSR could live with!

Incidentally, these were not the only records set by the type. On 11th August 1965 test pilot Marina L. Popovich set a female world speed record in a modified Yak-25RV, averaging 753.048 km/h (407.05 kts) over a 2,000-km (1,242-mile) closed circuit. Two years later, on 18th September 1967, she set another official world record,

Opposite , bottom: The second prototype ('76 Yellow') was completed as the Yak-25RV-I target aircraft. This view illustrates the bicycle landing gear with wingtip-mounted outrigger struts and the ventral oil cooler scoops on the engine nacelles. Note also the two extra pitots.

Below: Three-quarters rear view of the Yak-25RV, showing the tracer flares at the base of the rudder (a feature specific to the target version to facilitate night interception). Note the absence of airbrakes – a feature that caused problems for Yak-25RV pilots.

Side view of a production Yak-25RV ('20 Yellow'), showing to advantage the slim fuselage and the shape of the nosecone.

covering a distance of 2,497.009 km (1,550.93 miles) on a closed circuit.

State acceptance trials took place between 5th May and 1st August 1961. Pyotr N. Belyasnik was project test pilot; the Yak-25RV was also flown by Vasiliy G. Ivanov, Nikolay P. Zakharov, Vasiliy S. Kotlov, Pyotr F. Kabrelyov, Gheorgiy T. Beregovoy, Igor' I. Lesnikov and Viktor V. Yatsun. The trials turned up a few deficiencies. Due to the lack of airbrakes the Yak-25RV could fly at 12,000-16,000 m (39,370-52,490 ft) only with the gear down because, even with the engines at flight idle, it was overpowered and could easily exceed V_{NE}. Also, the lack of a de-icing system and exterior lighting meant the aircraft could operate in daytime visual meteorological conditions only.

The Soviet Air Force was not completely satisfied with the aircraft's performance; still, there was no alternative design. As the Yak-25RV did have a high service ceiling and good endurance (during a test flight on 10th April 1961 LII test pilot Boris V. Polovnikov stayed aloft for 5 hours 30 minutes), the VVS reluctantly gave the go-ahead for series production. After a few detail changes the Yak-25RV passed its State acceptance trials and entered production at the Ulan-Ude aircraft factory No. 99 under the in-house code *izdeliye* (product) 25RV. Production aircraft had two additional pitots flanking the nose-mounted air data boom; additionally, late-production Yak-25RVs had a flat-bottomed dielectric fairing aft of the main gear unit. The Yak-25RV received the NATO reporting name *Mandrake* in the 'miscellaneous' series.

In 1961 there was a curious episode when Belyasnik and Kabrelyov were ferrying the first production Yak-25RVs from Ulan-Ude to the GK NII VVS test facility in Akhtoobinsk. *'We were assigned flight level 12,000 m,* – Belyasnik recalled, – *but the aircraft would not maintain level flight at this altitude and we kept climbing all the while. When we were between Novosibirsk and Sverdlovsk the traffic controller requested our flight level. I replied "Zero sixteen"; I could not state in clear code that we were at 16,000 m. The irate controller ordered us to descend, otherwise he would send PVO fighters after us. I had to answer back impudently, "I don't care if you send the whole damn regiment after us – you won't get us anyway. We are not causing trouble for anyone, and we cannot descend."*

Starting in 1964 a handful of Yak-25RVs was converted for radiation intelligence (RINT) duties associated with nuclear weapons tests. Designated **Yak-25RR** (*radiatsi**on**nyy raz**ved**chik* – RINT aircraft), they had two underwing pylons (strut-braced on the inboard side) for carrying standardised RR8311-100 air sampling pods. Originally developed in 1964 for the Yak-28RR tactical reconnaissance aircraft, these pods had a nose intake closed by a movable cone and a paper filter which arrested dust particles, enabling their radiation level to be measured on the ground. Such pods were also carried by the Antonov An-12RR *Cub*, An-24RR *Coke* and An-30R *Clank* RINT aircraft, one of several Tupolev Tu-16R reconnaissance versions (*Badger-F*) and occasionally the Tu-95K-22 *Bear-G* naval missile strike aircraft. The drag generated by the pods impaired the aircraft's performance, reducing the service ceiling to 17,000 m (55,780 ft).

On 9th-26th October 1971 a modified Yak-25RR (c/n 25991201) underwent tests at the Yakovlev OKB's flight test facility in

Zhukovskiy. Designated **Yak-25RRV** (***rah****diotekh****nich****eskiy raz****ved****chik, vy****sot****nyy* – electronic intelligence aircraft, high-altitude), the aircraft was developed pursuant to ruling No. 111 issued by the Council of Ministers Presidium' Commission on Defence Matters dated 7th May 1968 to suit a Ministry of Defence requirement. The Yak-25RRV was based on the Yak-25RR. The air sampling pods were replaced with special pods housing a signals intelligence (SIGINT) system designated IRIS (*izme****rit****el'-reghi****strah****tor* ***im****pool's-nykh sig****nah****lov* – [electromagnetic] pulse signal measurement and recording device), aka *Vol****na****-S* (Wave-S); it was designed to detect and record electromagnetic pulses emitted by radars and the like. The cylindrical pods had parabolic dielectric fairings at both ends, with two probe aerials pointing forward and upward at the front; they were pressurised and heated by engine bleed air to make sure the equipment would operate normally at high altitude. The cockpit featured a new control panel for the SIGINT suite; some minor changes were made to other systems. Tests showed that the new pods and the associated air ducts had virtually no negative effect on the aircraft's performance. The Yak-25RRV was built in very small numbers (the exact quantity is unknown).

For the sake of completeness we may add that the *Mandrake* had a couple of other versions not associated with reconnaissance. These were the Yak-25RV-I manned target aircraft emulating high-flying spyplanes for the benefit of Air Defence Force fighter pilots (this did *not* involve live firing – only the gun camera would be used to record a 'kill') and the Yak-25RV-II remote-controlled target drone for live weapons training. Between 1961 and 1965 a total of 155 *Mandrakes* was built, of which less than half were regular Yak-25RV, Yak-25RR and Yak-25RRV spyplanes.

YAK-25RV IN SERVICE

The Yak-25RV stayed in service for about fifteen years until superseded by the Mikoyan MiG-25R and subsequent versions (see below). Performance-wise it was broadly similar to the U-2R, with the exception of range. Its safety record was quite good, no aircraft being lost in accidents. Apart from the southern and western areas of the Soviet Union, the *Mandrake* was deployed with the Group of Soviet Forces in Germany: an unidentified unit based at Zerbst in (former) East Germany operated three Yak-25RVs from 1966 until the early 1970s. In July 1966 these aircraft were used for target practice (probably for the Northern Group of Forces, i.e., Soviet forces in Poland), flying over Poland at 19,000 m (62,340 ft) and emulating Western intruders. Makes you wonder if this was also a photography practice mission for the *Mandrake* pilots! In 1962-63 the 14th *Leningradskiy* Red Banner GvIAP (*Gvar****dey****skiy istre****bit****el'nyy* ***a****via****polk*** – Guards Fighter Regiment) of the Southern Group of Forces, which was stationed at Kiskunlacháza, Hungary, operated two to four Yak-25RVs alongside its Mikoyan MiG-21PF *Fishbed-D* interceptors.

Oddly enough, despite being stationed in East Germany and Hungary the Yak-25RV was never noted over Western Europe (either due to extremely limited numbers or thanks to careful mission planning); at least, Western sources do not mention any sightings. On the other hand, it *was* noted over China, India and Pakistan. When the type was phased out in the early 1970s, surviving aircraft were either converted to Yak-25RV-II drones and shot down or simply scrapped. Fortunately, a single example survives at the Central Russian Air Force Museum in Monino near Moscow.

A flight of operational Yak-25RV-I; except for the tracer, they are outwardly identical to the 'pure' reconnaissance version. Unfortunately, as photography at Soviet airbases was expressly forbidden in the 1950s and 1960s, no high-quality photos of operational Yak-25RVs have surfaced to date.

THE *MANDRAKE* IN DETAIL

The following brief structural description applies to the production Yak-25RV.

The fuselage of basically circular cross-section changing to elliptical at the rear is a riveted semi-monocoque stressed-skin duralumin structure with 48 frames and 38 stringers; maximum diameter is 1.45 m (4 ft 9⅝ in.). The forward fuselage incorporates an avionics/equipment bay (frames 0-5) accessible via dorsal and lateral hatches; a metal nosecone carrying a PVD-7 pitot is attached to frame 0. The single-seat cockpit (frames 5-11) is enclosed by a sliding canopy with a fixed windshield incorporating an optically flat windscreen which is electrically de-iced. The canopy blends into a shallow spine housing control runs, piping and electric wiring. The nosewheel well is located between frames 4-9. The cockpit is pressurised and air-conditioned by engine bleed air which is cooled in a cooling turbine. The centre fuselage accommodates the fuel tanks and the mainwheel well (frames 19-23). The rear fuselage incorporates a camera bay with ventral doors between frames 31-33; it terminates in a metal tailcone attached to frame 44.

The cantilever mid-set wings of trapezoidal planform have no sweepback at quarter-chord. They are all-metal stressed-skin two-spar structures, the spars passing through the fuselage at frames 21 and 24. Each wing has 38 ribs and is built in two sections joined at rib 18. The outer wings terminate in tip fairings housing the landing gear outrigger struts. The wings have no high-lift devices and are fitted with two-section ailerons.

The sweptback cantilever cruciform tail surfaces are of all-metal stressed-skin construction. The *vertical tail* comprises a two-spar fin attached to rear fuselage frames 34 and 37, with a large root fillet, and a two-piece rudder. The *horizontal tail* comprises stabilisers and one-piece elevators; stabiliser incidence is adjusted by a hydraulic motor.

The pneumatically-retractable bicycle landing gear comprises a steerable nose unit with a single 600 x 155 mm (23.62 x 6.10 in) wheel, a main unit with twin 800 x 225 mm (31.49 x 8.85 in) wheels and outrigger struts with single 310 x 135 mm (12.24 x 5.31 in) wheels at the wingtips. The nose and main units retract aft, the outrigger struts forward. All units have oleo-pneumatic shock absorbers; the mainwheels have pneumatic brakes.

The Yak-25RV is powered by two Tumanskiy R11V-300 axial-flow non-afterburning turbojets rated at 4,000 kgp (8,820 lbst) for

Four views of the Yak-25RV in the open-air display of the Central Russian Air Force Museum in Monino. Note the camera window fairing, seen in the three-quarter rear view, under the rear fuselage, with the radio altimeter dipole aerials fore and aft of it, and the absence of trailing-edge flaps on the wings.