SAAB Sk 60

More than 50 years after its maiden flight, the Saab 105 still forms the backbone of the Swedish air force pilot training school.

Text and photos: Emiel Sloot

The Flygskolan located at Linköping-Malmen is the main operator of the Sk 60, as the Swedish air force designates its Saab 105s. In 1958, Saab started a study known as Project 220, that later developed into a two-engined jet trainer design for the Flygvapnet, to replace the Vampire T.Mk 55 (local designation Sk 28C). On 16 December 1961, the government approved the programme to develop such an aircraft, now known as Saab 105. Two prototypes were built and the first flew on 29 June 1963. The defence ministry subsequently acquired 130 aircraft on 6 March 1964, an order expanded to 150 – serialled 60001-60150 – one year later to cover for additional aircraft in a light attack configuration. Limited export success was achieved with 40 General Electric J85-powered Saab 105OEs sold to Austria.

Various versions

All Swedish 105s were built in the basic version for use as trainer and liaison aircraft, designated Sk 60A. The first production model flew on 27 August 1965. The Försökscentralen test unit at Malmen flew extensive trials with the first examples, before deliveries to the flight school started in April 1966. By 1968, all 150 had been delivered. These were powered by Turboméca Aubisque engines (6.8 kN/1,540 lb thrust, locally designated RM9). The engines were later boosted to 7.3 kN/1,640 lb and dubbed RM9B.

Upon the introduction of the Sk 60 with the Flygvapnet, a requirement for light attack duties was also issued. In view of this, 46 Sk 60As were

retrofitted at the air force's central workshop at Linköping-Malmen with a Ferranti F-105 ISIS weapons sight from 1970. On three hardpoints underneath each wing, up to 12 Bofors 13.5-cm rockets could be carried for light attack and weapons training. These aircraft were designated Sk 60B.

The first Sk 60C (60010), being an A-model but converted before delivery, made its first flight on 18 January 1967. For this version, the nose was stretched to house a Fairchild KB-18 photo camera (local designation SKA 29) for aerial reconnaissance, alongside S 35E recce Drakens. For close air support, the aircraft could be fitted with Bofors rockets and two FFV/Matra SA-10 Aden 30-mm cannon pods. Another 29 A-models were converted similarly at Malmen to Sk 60Cs.

In 1976 and 1977, another three Sk 60As were modified at Malmen, this time to Sk 60D transport and liaison aircraft that were fitted with civilian-style avionics and instruments calibrated in feet and knots (rather than metres/kmh, that was the standard within the Flygvapnet, until the introduction of the JAS 39C Gripen). A second VOR/DME and ADF receiver was installed as well as a transponder with altitude reporting, while the ejection seats were replaced by fixed seats. The Sk 60D made its first flight on 2 March 1977. In this configuration, they were used for VIP and liaison flights within the country and abroad, and operated mainly out of Stockholm-Bromma.

During 1979 and 1980, 10 more were converted similarly to Sk 60E navigation trainers. These aircraft were used primarily by the Trafikflygarhögskolan at Ljungbyhed to train commercial pilots, who simultaneously became air force reserve officers. Both the Sk 60D and -E were retired in 1999 and 2001, respectively.

New engines

Between 1988 and 1991, the 142 remaining aircraft were structurally overhauled including fitting new wings. Following a contract signed on 4 November 1993, Saab Aircraft conducted a re-engine programme between 1994 and 1998, in which airframes exchanged their RM9B Aubisque engines for Williams-Rolls Royce FJ44-1A power plants (RM15). The new engines, digitally controlled by a FADEC (Full Authority Digital Engine Control) delivered 15 percent more thrust (8.45 kN/1,900 lb each). Additional benefits were less weight thus lower fuel consumption, improving the range from 1,900 km (1,026 NM) to 2,550 km (1,377 NM), and lower maintenance costs. The new engines were built in at Ljungbyhed air base, while the air intakes had to be slightly modified at the Saab factory in Linköping.

The first aircraft (60072) flew in August 1995. The original contract covered 115 aircraft (A, B and C models), but for budgetary reasons this number was later decreased to 106. Redeliveries started in September 1996. In 1999, some re-engined aircraft encountered problems due to the higher engine bleed air pressure towards the air conditioning packs, even causing a few pack turbine explosions, making additional modifications necessary.

Swedish service

When the Sk 60 entered service, it mainly equipped the Flygskolan at Ljungbyhed, also known as F5 Wing. Initially, new pilots graduated on the Sk 50 Safir (later Sk 61 Bulldog) before moving on to the Sk 60A for further training. As of 1987, new pilots start training directly on the Sk 60. Advanced tactical training was then conducted with F20 Wing at Uppsala, equipped with a mix of Sk 60B and -C aircraft.

Beside the mentioned units, some Sk 60Bs and -Cs equipped the 3rd Division of F21 Wing at Luleå-Kallax from 1973. After this unit disbanded in 1982, these aircraft transferred to F20, that soon became part of F16 at the same base, using these aircraft in the same training role.

The three four-seat Sk 60D aircraft for VIP flights and liaison in view of the air force staff in Stockholm were initially operated by F18 at Tullinge, but later transferred to F16, although the aircraft mainly operated out of Stockholm-Bromma. The various operational fighter wings of the Swedish air force operated a handful of Sk60s each for their liaison flights.

Flygskolan

The Swedish air force flying training school or F5 Wing had been based at Ljungbyhed in southern Sweden since 1925, until the base closed in late 1996. The Flygskolan subsequently moved to nearby Ängelholm, where it integrated within F10 Wing. However, F10 was selected to disband a few years later, in December 2002, thus the HQ decided in 2001 to move the school again, this time to its present home base Linköping-Malmen. Due to reconstruction works there, the school first temporarily relocated to Uppsala, where the tactical part of the flying training was already based for a few decades. On 1 July 2003, the wandering around Sweden came to an end, and operations from Malmen started.

The unit was temporarily under command of the Ronneby-based F17 wing, until the latest reorganisation came into effect on 1 January 2006. As a result, the school is now controlled by the Luftstridsskolan (LSS – Air Combat School) at Uppsala, which is responsible for a number of other air force training units as well as the test and evaluation units for the Gripen and the armed forces' helicopters, both also based at Malmen.

Today, the Flygskolan consists of four units. New pilots selected for flying training start their practical education with the 1. Division (1st squadron), also known as the Grundläggande Flyg Utbildning (GFU – Basic Flying Training). Its syllabus comprises 125 flying hours including 39 solo, and lasts for one year. Military training is then continued at the air force academy in Stockholm, whereafter trainees return for the second part of flying training with the 2. Division (2nd squadron) or Grundläggande Taktisk Utbildning (GTU – Basic Tactical Training). This part – previously undertaken by F20 and F16 Wings, respectively – lasts for another year and takes some 145 flying hours including 55 solo. The graduated pilots move to the JAS 39 Gripen OCU with F7 Wing at Såtenäs. Since 1995, new transport pilots also join the Flygskolan for training (GFU and part of the GTU course) while new helicopters might in future also join the GFU, although a decision on this has yet to be taken at the time of writing.

A third unit is the Utbildnings Sektionen (Education Unit), which handles the 14-week Flight Instructor Courses. Finally, the Team 60 flight demonstration team completes the Flygskolan.

Basically, the Flygskolan only used the Sk 60A and -B for training while the longnosed Sk 60Cs were largely detached to the transport and liaison flights of the JAS 39 Gripen wings F7, F17 and F21.
While the Sk 60 is basically equipped with two side-by-side ejection seats, these can be exchanged with four fixed seats for liaison purposes. In this configuration, limitations apply in view of maximum g-loads and flight manoeuvres (no aerobatics allowed), while close formation flying is also prohibited.

Remarkable training results
The pedagogic philosophy applied by the Flygskolan was established in the 1970s and refined over the years. It is significantly different compared to other foreign military pilot training courses. New pilots who successfully finished the tough selection process and initial military training at the academy, enter the GFU course without any previous flying experience. The training philosophy puts a high level of responsibility to the student pilots, aiming to make them both self-confident and self-critical. In this light, a substantial part of the syllabus is performed solo, to improve the student's airmanship. On the other hand, the relation between instructors and student pilots is kept at an open level and rather 'horizontal' from an authority point of view, resulting in decreased student stress levels, as learning to fly is stressful enough by itself, according to the philosophy.
When a sortie is debriefed, the instructor and student first discuss the flight in the classroom, without grades noted in view of the results. Then, both write down their own thoughts on the particular mission independently into their own flight diaries. At the end of the week, both will join and compare their notes, to check if both opinions match on what went good and what could be improved.

The approach has proven to be very successful, as over 90 pct of the initially selected pilots make it to combat-ready level. Both the GFU and GTU courses have a capacity to start a course of ten pilots each year.
On 1 January 2009, the Flygskolan moved into a new building, adjacent to their new hangars and flightline. The building is designed according to the training philosophy, with open offices and a joint coffee room for both instructors and trainees, although both groups have their own briefing rooms for practical purposes. Despite the new infrastructure, the armed forces are currently investigating to move the Flygskolan once more, this time to Såtenäs, to have it colocated with the Gripen OCU. The decision will have to be made at political level.

New maintenance contract
On 19 December 2008, the Forsvarets Materielverk FMV (Swedish Defence Material Command) signed a contract worth SEK 900 million with Saab Aerotech, in which this company will undertake maintenance for the whole remaining Sk 60 fleet (then 80 aircraft) from 2009 till 2017. The contract contained options for additional flying hours and extension beyond 2017. Line maintenance is done at the home bases of the F7, F17 and F21 wings, and the Flygskolan. Other inspections and overhaul would be carried out at the maintenance facilities in Ljungbyhed and Nyköping. Saab Aerotech also provided spare parts and would cooperate with Williams in view of engine overhaul and maintenance.

Team 60
Instructors of the Flygskolan form the Team 60 demonstration team. In 1974, F5 wing had set up a display with two Sk 60s. One year later, two more were added, and soon after, the formation was expanded to six aircraft with a first rehearsal in November 1975. Following approval of the Swedish air force commander early 1976, Team 60 (referring to the type designation) was officially established. The first demo was performed over Göteborg-Säve on 15 May 1976, and the first appearance abroad was over Skrydstrup, Denmark in 1980. Since then, Team 60 visited several air shows outside Sweden. During the Royal International Air Tattoo (RIAT) 1996 at RAF Fairford, the team won the Sir Douglas Bader Trophy for the best overall flying display.

Unfortunately, no demos were flown during 1989 and 1990 due to lack of pilots, while the 1999 season was cancelled due to engine-related problems. After that, the team was forced to display with four aircraft only due to pilot shortage but in 2004, the team was back on full strength.

Team 60 could put up three different displays, depending on the visibility and cloud base. Seven Sk 60As have been sprayed in the Team 60's colours (serialled 60033, 61, 62, 96, 98, 125, 139). A problem related to the FJ44 engines was that the diesel injected into the exhaust to create smoke did not ignite, due to the lower exhaust temperature. The engine manufacturer did not allow for extensive modifications, so to counter this, smoke pods filled with TEXPAR 15 diesel fuel were attached under each wing from 2001. In 2006, TEXPAR 22 was introduced supplying a more dense and lasting smoke cloud.

Budgetary problems forced the team's grounding in 2007. Since then, only few displays were flown. Also, the 2009 maintenance contract with Saab did not provide for Team 60 in view of extra flying hours and stress to these airframes.

Avionics upgrade

The retirement in December 2012 of the first generation Saab JAS 39A Gripens equipped with metric-style flight instruments, highlighted the desire to adopt new avionics for the Sk 60 trainer aircraft in the light of standardisation. In addition, the installation of more modern navigation devices was considered as highly useful, as in previous modification programmes, the cockpit interior had been largely untouched.

On 21 September 2009, the FMV awarded an order worth SEK 130 million to Saab, to upgrade the instruments in a limited number of aircraft. The list of mandatory requirements presented by FMV covered the earlier mentioned feet and knots presentation on all instruments to harmonise the air force fleet; new radios with 8.33 kHz channel separation enabling operation abroad throughout European skies; Mode-S transponders; global positioning system (GPS); a g-warning system; and an aircraft parametric registration system. An additional wish-list with optional requirements was also forwarded, including installing an autopilot with at least basic functions such as heading and altitude hold, simulated weapons for tactical training, digital flight instruments including a multi-function display (MFD) as well as a head-up display (HUD) and compatibility for night vision goggles (NVG). Unfortunately, budget limitations caused that none of these extras were implemented.

Sk 60AU

As by contract, Saab did all the design work and installation of the new equipment. Avionics selected and installed in the process are the LITEF LCR-100 gyrocompass AHRS (Altitude and Heading Reference System); a Garmin 430W combined GPS navigation and VHF communications set; a Garmin G TX330D Mode S transponder; and a Catron CA-1326 Audio panel. New flight instruments include a Sandel SN3500 digital HSI (horizontal situation indicator), while the Swiss Thommen AG supplied 3-in air data instruments including an AD32 altimeter (left seat), a 3A63 Altimeter (right seat), two 5C15 Mach/airspeed indicators (left & right seat) and a 4A16 vertical speed indicator. Audio tones at 5.5 and 6 g warn the crew when approaching and reaching the airframe g-limit, respectively.

While the actual cockpit conversion was undertaken at both Malmen and Ljungbyhed air bases, initial testing was carried out from Saab's Linköping site. For follow-up flight testing and evaluation, Sk 60B 60048 was used for the first test phase, basically covering the whole upgrade project. Thereafter, Sk 60A 60079 was allocated to the second test phase,

addressing some issues that arose in the process. Both aircraft were operated by the FMV's Malmen-based unit.
An initial operational capability date was set at 1 July 2012. Exactly one year later, the Flygskolan reached full operational capability on the type. Thereafter, the base flights at the air force's three Gripen wings F7, F17 and F21 changed their aircraft for modified ones.

Beside the two test and trials aircraft, a total of 35 Sk 60A/B were fitted with the new systems, unofficially dubbed Sk 60AU (Avionics Upgrade). Three more kits have been bought for possible future use. Principally, the Sk 60AU is not a new version, but rather a change to existing ones. This approach made the certification process far less complicated.
The modification programme was completed mid-2014. As a result, all unmodified aircraft including the few remaining Sk 60Cs were disposed of. A number of the surplus aircraft were kept stored at Ljungbyhed.

Operational use
Soon after the introduction of the Sk 60AU, two particular downsides came to light. The LCR-100 gyro initially operated in a mode unsuitable for the aircraft's performance. Operation of the gyro in a more advanced mode fixed this. Another issue involved the GPS. Since its antenna is located on top, the signal is lost quite easily when doing certain manoeuvres. Subsequently, it takes minutes to regain a valid GPS-position. A software update successfully solved this problem.
During April 2014, Flygskolan's GTU took the Sk 60AU up for live firing of Bofors 13.5-cm rockets, a practice that had not been carried out for a number of years. Unfortunately, after firing some ten rockets, the FMV discovered that the maintenance of these weapons had not been carried out according to protocol, so the exercise was halted. It is unclear if such practices will be continued in the future.
Night flying is a part of the syllabus that is exclusively carried out by the GTU. During the winter season, each student accumulates 10 hours of night navigation, instrument approaches and touch-and-goes, covering 10 sorties. Night flying is carried out on Tuesdays only, from November to February. The Sk 60AU's cockpit has not been made compatible for night vision systems, so students will not master this until the Gripen course.

Replacement
Fitted with the new systems, the Sk 60AU is again suited to be of good use in the Swedish fighter pilot training programme. Still, while proved strong, reliable and well maintained, the airframes have already reached a distinctive age. Replacement will be necessary in the not-too-distant future. Various variants have already been studied for several years now, ranging from buying a new training system like the Pilatus PC-21, combining efforts with one or more other nations such as Finland, to joining an international flight training centre abroad. A final decision has yet to be taken, and with the latest avionics upgrade, the Swedish military bought some additional time to consider its options. ■

Sk 60 serials in Swedish air force service

Sk 60A: 60001-60150 (Sk 60B-E are all conversions from A-models, except for 60010 that was already converted to Sk 60C before delivery)
Sk 60B: 60034-60039, 60041-60042, 60044-60046, 60048-60050, 60052, 60054-60060, 60063-60077, 60080, 60082-60083, 60085-60087, 60089-60091
Sk 60C: 60001-60007, 60009-60028, 60030-60032
Sk 60D: 60097, 60131-60132
Sk 60E: 60140, 60142-60150

Aircraft that received the avionics upgrade ("Sk 60AU") are:
60033, 60036*, 60038*, 60040, 60041*, 60045*, 60048*, 60058*, 60061, 60062, 60063*, 60073*, 60079, 60083*, 60086*, 60088, 60096, 60098, 60100, 60101, 60104, 60105, 60109, 60112, 60114, 60115, 60116, 60118, 60123, 60125, 60126, 60129, 60133, 60136, 60137, 60139 & 60141
(* Sk 60B)

This article, as well as parts of it, have been published in various aviation magazines such as Combat Aircraft (UK – Vol.12 No.2), Ptisi (Greece – No.298) and Aranysas (Hungary – Mar2007). Furthermore, images have been used for various purposes, including a Saab 105 book published by the Swedish Aviation Historical Society.

A separate article was completed on Team 60.