

# The Nanchang CJ6

## A Historical Summary

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### Background

The first aircraft designed by China itself was the jet aircraft, which reflected the high standard. Design and manufacture were basically successful as proved by the initial flight test. It was regretful that this type of aircraft had not been put into batch production because of a change of the Air Force flight training system. However, it opened up the road of aircraft design in new China, primary trainer CJ-6, Q-5 series attack aircraft and J-8 series fighter were designed by this design department which later developed into design institute, on the basis of JJ-I. Therefore, the flying of this aircraft was worthy commemorating, which had been talked about widely even today.



Fig. 11 Organizers, designers and test pilots of primary trainer CJ-6

The Chinese designed primary trainer CJ-6 was the successor of primary trainer CJ-5, developed as a trainer to link up JJ—I in the training system. The aircraft was designed starting from the later half of 1957 by design department of the Shenyang Aircraft Factory. When the initial design was finished in May 1958, the design was continued in the Nanchang Aircraft Factory and also manufactured there. Test of the first aircraft was made in August and later went to Beijing to join the flight demonstration. Test flight was finished in December 1960. In 1961, its engine was changed to the Chinese-made piston engine HS6 from the original Czechoslovakian engine. Piston engine HS6 was certified by the state and released for batch production. This was the first aircraft designed and batch produced by China. About 1,796 such aircraft were manufactured by the end of 1986, and they were in service with the Air Force, the Navy air force and aviation schools as well as the Chinese civil aviation and friendly countries. The aircraft was awarded National Gold Medal for Quality in 1979 due to its good performance and high Quality.

By 1959, two types of fighters, one type of trainer, small transport and helicopter were already trial manufactured by the Chinese aviation industry; the Chinese designed JJ-I and Primary Trainer CI-6 had also flown. There appeared a prosperous scene of production and trial manufacture of aircraft and engines of more types. But people also understood that all aircraft produced were small size aircraft and efforts should be made to manufacture larger aircraft with reater take-off weight, especially bomber aircraft, which was put in the development program by Premier Zhou Enlai in the initial stage of the aviation industry construction. Great concern was also shown by Defence Minister Peng Dehuai. When the First Five-year Plan was completed ahead of schedule in 1956, the aviation industry began to prepare for the construction of bomber aircraft factory. In 1957, agreement was reached with the Soviet Union regarding introducing Russian manufacturing technology of Tu-16 Bomber. But the newly built bomber aircraft factory lagged behind its schedule because of the change of construction site. To fill in the gaps in China's bomber aircraft, Harbin Aircraft and Engine Factories actively undertook preparations for Tu-16 trial production. Sample aircraft, drawings and part of technical documents were introduced at the beginning of 1959. The first Tu-16 aircraft assembled with Soviet made parts and components was flight tested before National Day (October 1) of 1959, which provided a good and effective practice for the later trial manufacture. This bomber was designated H-6.

The Chinese aviation industry concentrated on the development of aircraft and simultaneously considered trial production and regular production of missiles during this period of time. The missile development was included in China's 12 year science and technology development plan formulated in 1956, In April 1956, Premier Zhou Enlai presided over a special meeting to discuss China's missile development. Development of missiles and rockets in industrially developed countries was progressing very fast. More over, there was a popular opinion in favour of missile instead of aircraft. There were three opinions to the issue of handling development relations between aircraft and missile in China: some held to carry out development and trial production of missiles in China with every efforts; others insisted on the simultaneous development of aircraft and missile and still others said missile development first in first five years and then came back to aircraft development again. After repeated discussions

## Chapter IV Development of Trainers and Fighters

### Section 1 Appearance and Development of Primary Trainers

Trainers are the aircraft used for training pilots. There are either tandem seats in fore and aft cockpits, or two side-by-side seats in a single cockpit, inter-connected dual controls and two sets

of instruments for use by an instructor and a trainee. Generally the trainers are divided into 4 classes, i.e. the primary trainer, the basic trainer, the advanced trainer and the fighter-trainer.

During its growth the Chinese aviation industry has consistently felt its duty to develop quality aircraft to satisfy the needs of the military services and airlines in their operation and training. Importance has also been attached to the development of trainers while various other aircraft were developed and produced. The first aircraft marking the transition from aircraft repair to manufacture was a primary trainer indeed. Afterwards the fighter-trainers and bomber-trainers were also successively developed. By 1986 a total of 4,056 trainers in various types, approximately one third of the total aircraft made in China, were produced. With these trainers the military needs in training have been basically met and large quantities of superior pilots have been trained. Some trainers have also been sent to other countries to assist training their pilots.

### 1. Appearance of the CJ-5 Primary Trainer

A primary trainer is used for training potential trainees to master primary flying techniques because of its low speed, good controllability and stability. These factors make the task of learning simpler. The CJ-5, manufactured by Nanchang Aircraft Factory, was a licence production of the Soviet primary trainer Yak-18 developed in 1946. It had a frame type fuselage, a wing with one rectangular center panel and two tapered outer panels and a tailwheel type landing gear. A piston engine drove a wooden propeller. The flying instruments, engine instruments, a transceiver, a directional gyro and an interior communication system, etc. were installed to enable the trainees to learn the operational skills of the aircraft after they had finished the primary training programme

In accordance with the First Five-year Plan of the aviation industry approved by the government, the trial production of the CJ-5 was to be completed in September, 1955. But it was decided to cut this by 1 year as the Chinese Air Force was in urgent need of a primary trainer and the Nanchang Aircraft Factory had already mastered aircraft repair techniques, and techniques for manufacture of parts and components for 5 types of aircraft including the Yak-18. After the assignment of this task the factory proceeded rapidly under the instruction of some Soviet experts and the organization of chief engineer Li Shaoan and chief technologist Gao Yongshou. First CJ-5 was delivered to the flight test station in June for flight test on June 30 and second full size airframe began its static destructive test on May 12.

Aircraft static destructive tests were totally new to the factory at that time and this was the first of its kind ever carried out even in China. There were no Soviet experts for consultation. A project engineer, Zhang Azhou who studied in the United Kingdom and had just returned to China, was put in charge of the test. Zhang Azhou asked all his staff members to study all available Soviet data on static testing and made careful preparation for the test. Under his orderly command load applying, instrument reading and data measuring and recording were carried out as planned. When the load was increased to 105—110 per cent of the ultimate load, a sudden thundering sound came out and the airframe broke at the front spar of outer wing panel. This was a proof that the strength of airframe was in conformity with design criteria and this first destructive static test of a full size airframe was a complete success. Later on the static tests were also successively carried out in 57 design cases on 14 major components, e.g. central wing panel, aileron and fuselage, showing that their strength was in compliance with design criteria. All static tests of CJ-5 had been thus completed and the strength of the aircraft was proven, Zhang Azhou made an outstanding contribution to the static test programme and, therefore, was awarded a special-class merit.

The first flight of the first aircraft made in new China, the CJ-5, took place on July 3, 1954. Piloted by Duan Xianglu, the aircraft had a successful flight and made a safe landing. On July 20 the State Flight Test Commission came to the conclusion that the performance of CJ-5 was in conformity with its specification and therefore it was agreed that the aircraft should be put into mass production and be delivered to the Air Force for use in training. A celebration of the successful production of the first CJ-5 was held at the factory on July 26. Zhao Erlu, minister of the Second Ministry of Machine Building, Shao Shiping, the governor of Jiangxi province, Duan Zijun, deputy head of the Aircraft Industry Bureau, and other leaders from the Air Force came to the celebration. Three CJ-5s made a flight demonstration. A telegram reporting the success to Chairman Mao Zedong from ail staff and workers of the Nanchang Aircraft Factory was passed during the celebration.

After the mass production of CJ-5 was approved in August a total of 379 CJ-5s were produced from 1954 to 1958 and delivered to the Air Force, the Navy air force and CAAC. The CJ-5 made a great contribution to the training of pilots in the early days of new China.

## 2. Independent Development of CJ-6 Primary Trainer

Further progress in the pilot training of the Air Force raised a requirement for a primary trainer with tricycle landing gear and better performance than that of the CJ-5. By that time the Yak-18A, a derivative of the Yak-18 with tricycle landing gear had been developed in the Soviet Union and its drawings delivered to China. Xu Shunshou, project chief designer of the aluminum material was in mass production. Therefore, he suggested developing a more advanced primary trainer to suit the conditions in China. His suggestion was accepted. The design work began soon after designers' visits to Air Force bases where they made investigations and interviewed pilots. Lin Jiahua and Cheng Bushi took the responsibility of general layout design. From later part of 1957 to May 1958 the conceptual definition study, general layout design, wind tunnel test, performance analysis and preliminary design of the structure and systems were successively completed. A mockup in 1:1 scale was manufactured in the Shenyang Aircraft Factory, According to the general configuration the CJ-6 was evidently better than the CJ-5 in its performance, especially in flight speed, rate of climb, controllability and pilot's vision. It was decided by the Aircraft Industry Bureau in May, 1958 to transfer the development of the CJ-6 to the Nanchang Aircraft Factory. An Aircraft Design Department was established in the Nanchang Aircraft Factory and more than 20 designers including Tu Jida and Lin Jiahua were sent to assist the Nanchang factory by the Shenyang. Aircraft Design Department, The upper authorities appointed Gao Zhenning project chief engineer and Tu Jida and Lin Jiahua deputy project chief engineers. Due to the joint efforts of the two design departments a complete set of drawings in 5,177 standard pages were released in a short period of time.

Immediately after the release of these drawings, workers, with a sense of pride in manufacturing an aircraft designed by their own people established new records one after another; the sub-assembly by riveting took only two weeks to finish and the final assembly only 1 days and nights.

The static test of a full size CJ-6 airframe and drop test of its landing gear showed its compliance with design criteria.

First flight of the CJ-6 by test pilots Lu Maofan and He Yinxi took place on August 27, 1958. In September two CJ-6s were ferried to Beijing and made a flight demonstration there to the leaders of the Military Commission of CCCPC. A severe technical problem was found during the first flight. The engine and propeller made in Czechoslovakia did not match each other so that the CJ-6

could not fly at high speed. In August 1959 project chief designer Ye Xulun proposed to retrofit the CJ-6 with Soviet A-14P engine and P530D35 propeller. His proposal was accepted and a retrofitted CJ-6 began its flight test by two pilots including Huang Zhaolian on July 18, 1960.

Huang Zhaolian was a test pilot for the CJ-5 national certification programme. He had flown many airplanes made in Germany, Japan, Italy, the United Kingdom, the United States of America, France and the Soviet Union with a total of 5,000 flying hours. During the flight test he undertook the most difficult and dangerous tasks—spin. Spin is a kind of unintentional motion occurring when the angle of attack is beyond the critical angle of attack, in which the center of gravity of the aircraft descends rapidly along a steep helical line while rotating about its three axes. This is an unusual flight condition which will end in a crash if the aircraft can not be recovered from the spin. The primary trainer is required to have good spin characteristics so that a trainee may practice the spin and to learn how to recover.

The answer to the question of whether the CJ-6 could recover from a spin was unknown because the spin test were not conducted in a vertical wind tunnel. Although the technical people had carefully carried out a theoretical analysis and some emergent safeguards against accidents such as the installation of an anti-spin chute had been adopted, the risk involved in the flight test still existed. Huang Zhaolian made a detailed theoretical analysis of the spin and practiced recovery actions repeatedly before actual flight until he was confident of a successful flight. At nine o'clock in the morning on November 16, 1960 he started his spin flight test. He made a check of stall, then tried the spin from half circle to three circles. Every time he recovered successfully and so fulfilled the task of spin flight.

In 1961 the CJ-6 was redesigned in the Nanchang Aircraft Factory and another prototype aircraft was produced for certification in an attempt to overcome the following four major deficiencies found in its flight test: temperature too low at engine cylinder heads, poor heat dissipation of oil system, unwanted right yaw and unbalanced fuel consumption between right and left fuel tanks. The flight test of the new prototype aircraft was completed on October 15. A total of 1,800 takeoff-and-landings and 612 flying hours were accumulated. The Military Products Certification Commission of the State Council certificated the CJ-6 and approved its mass production on January 5, 1962.

In 1963 the HS6 piston engine and the propeller used on the CJ-6 were successfully produced. Since then all aircraft parts, components and accessories have been made in China.

An uprated engine HS6A was certificated in December, 1965. A derivative of the CJ-6 with the HS6A engine was designated as CJ-6A.

The development of the CJ-6 took four and a half years, a rather short period for an aircraft developed on our own. The reasons for this short development period were the unsophisticated nature of the CJ-6 itself, its practical and realistic design philosophy and moderate aircraft performance requirements. The CJ-6 had its own distinguishing features in aerodynamic layout, i.e. emphasis on controllability and safety. In performance it was as advanced as similar aircraft in the world. Domestic airborne equipment were chosen as much as possible for use in the aircraft. This maximum use of what was available in China made it possible to concentrate on the improvement of the performance of the new aircraft.

Various difficulties were encountered and many setbacks suffered in the development of the CJ-6. Its development was almost stranded in its early stage of development because of improper selection of the engine. In addition it met strong competition from the Yak-18A. With support from higher authorities, the leading cadres and scientific workers at the Nanchang Aircraft Factory kept on with the development. They overcame all difficulties one after another, worked steadily and made solid and uninterrupted progress. At last they succeeded.

From 1964 to 1966 ten CJ-6Bs with armament mounted were retrofitted at the Nanchang Aircraft Factory.

The CJ-6 was awarded a National Gold Medal in 1979. A total of 1,796 CJ-6s in all versions were produced from the beginning of production to 1986. It has not only made great contribution in training tens of thousands of pilots in China, it has also been flown by many countries around the world.