CCV-F-104G A HISTORICAL CORNERSTONE

The first artificially stabilized aircraft flew 20 years ago

Picture above:
The CCV program was tested in a F-104G (Starfighter). In 1981 and 1982 the aircraft flew with its most unstable configuration: canard control surfaces and tail ballast.

Picture beneath:
Earlier test flights were done without the canard control surfaces.

TWENTY YEARS AGO, on 20 November 1980, the experimental aircraft CCV-F104G took off from Manching. It was the first take-off in a so-called E1-configuration, i.e. a destabilizing canard wing was mounted onto the fuselage behind the cockpit.

A modified F-104G Starfighter was used to test the CCV flight control system (Control Configured Vehicle). For the experimental program natural stability was renounced. Parallel to the flight control system normally installed in the F-104 series production aircraft a newly developed digital "fly-by-wire" flight control system assured an "artificial" stabilization of the unstable test aircraft and the appropriate and required flight properties of longitudinal and lateral movements. The ability to artificially stabilize unstable aircraft configurations was a prerequisite for the design of a new military and commercial aircraft generation and is still considered to be a key technology area. The technology used for the CCV program was the starting point for the design and development of the flight control system for Eurofighter.

During the 45-minute test flight, CCV project pilot Nils Meister was at the controls of the modified Starfighter. Although the mounting of destabilizing canard wings considerably changed the aerodynamic characteristics of a normal F-104G, the CCV flight control system ensured stable flight characteristics.

Dr Gerhard Loebert, former CCV program manager, explained in MBB-aktuell (a MBB newsletter): "The goal of this flight was not to attain spectacular instability values as the aircraft remained within the neutral stable range. It was far more important to prove the efficiency of the CCV system – and we managed to do so."

The performance of the CCV-F-104G team was honored this fall and the team was awarded the Badge of Honor of the Gesellschaft für Luft- und Raumfahrt (DGLR; German Aviation and Space Association). The CCV program was a major milestone in the conception and development of the Eurofighter.

Daniela Bommer

Erwin Kunz, who today works in the MT6 division, was the CCV flight test manager at Erding at the time.
M forum interviewed him about the program.

How long did you work for this program?

After approximately five months of familiarization I was appointed manager of CCV testing in June 1977. We successfully completed the program in 1984 after 176 test flights. During this time we proved the functionality of the CCV system and all its components, various CCV control versions for stable and unstable configurations, a back-up control and a modern autopilot were successfully developed and tested. And already at that time we knew that our program was the cornerstone for a modern combat aircraft. The far-reaching consequences for the conception and development of the Eurofighter naturally only became apparent years later. We were delighted that the DGLR has now honored this achievement.

What was the greatest challenge of this program?

Without any doubt the greatest challenge of the program was to develop a flight control system for unstable aircraft configurations within the extremely narrow limits of a cost and time frame and – on the other hand – to safely demonstrate and prove the operativeness and the efficiency by flight testing. There was not enough a/c model information available, therefore we had to derive the required data from test flights. Subsequently, another challenge was to recognize the risks of the development trials required by a completely new flight guidance system concept. Accordingly, we had to define and plan the test steps in such a way as to eliminate the probability of catastrophic events occurring.

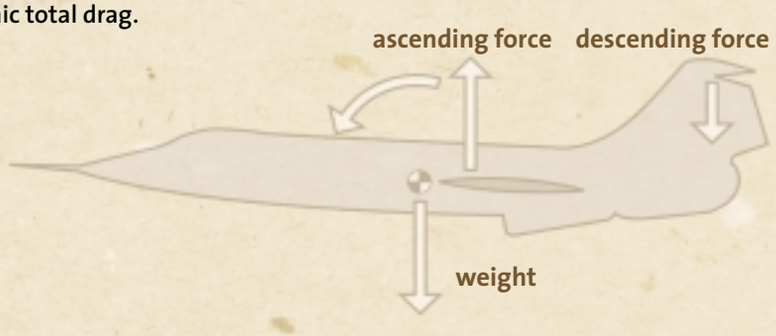
How did testing in the old days differ from flight testing today?

It is extremely difficult to make a fair comparison. First of all, Eurofighter the present test object, is not an in-house experimental program, and secondly, 20 years ago it was still possible to act quickly and adequately in an individual, unbureaucratic way. In extreme situations we were still able to implement or realize any necessary modification within a couple of days. As far as the testing was concerned, in those days it was possible to be far more efficient, because formalism was only applied where formalism was necessary.

The CCV in its final configuration with ballast and canard wings.

COMPARISON OF STABLE AND UNSTABLE CONFIGURATIONS

In the case of traditional, aerodynamically stable aircraft, the ascending force of the wings is induced behind the center of gravity. In order to equilibrate the resulting top-heaviness, a downward force must be generated at the horizontal tail unit. This reduces the ascending force and increases the aerodynamic total drag.



If the ascending point is in front of the point of gravity, the horizontal tail unit induces the ascending force and the total drag decreases. However, the aircraft is no longer stable and must be actively controlled (CVV).