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AVRO ARROW

RESEARCH TO ROLL-OUT

AVRO AIRCRAFT LIMITED

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Canada's first supersonic aircraft, the CF-105 Avro Arrow, was unveiled today at Avro Aircraft Limited, Malton, Ont.

On a signal from Defence Minister George R. Pearkes, V.C., the huge white delta-winged fighter emerged from the production bay before a massed gathering of government, military, civic and industrial leaders, and employees of the company. Overhead, CF-100's flown by Avro test pilots, swooped low in salute across the big crowd.

This was the first public viewing of the supersonic successor to the CF-100, as the Arrow has been under security restriction throughout its design and production stages.

Initial flight testing of the Arrow will be carried out from Malton. Next week the new aircraft will start undergoing a series of complete ground tests covering engine run-up, fuel, electrics, hydraulics and similar systems. Runway trials will follow and then the first flights.

Roll-out of the first Arrow in a record four years from the time Avro was given the "go ahead" to design and manufacture a successor for the CF-100, climaxes a mass of engineering research and manufacturing techniques in fields completely unknown when the project was undertaken.

It was in July 1953 that the government authorized a design study of the CF-105, which was the code name first given to the Arrow. Within two months the first wind tunnel tests were being run. These ranged from slow speeds to twice the speed of sound, and 17 models of various sizes were used to obtain necessary structural and aerodynamic data.

Wind tunnel limitations caused Avro engineers to explore further techniques for obtaining important aerodynamic data. Eleven large scale free-flight models with rocket-propelled boosters were fired at ranges in Canada and the United States between 1954 and January of this year. These models, simulating the flight of the full scale aircraft, were instrumented and transmitted their in-flight information back to a ground station.

During 1954 when preliminary design was completed, the RCAF adopted the CF-105 designation for the aircraft. Later in 1954 power plant problems arose which required major changes in the proposed program. The Rolls Royce RB 106 engines which were incorporated in the design would not be available in time for the CF-105, and were replaced by two Curtiss-Wright J67 engines. Then, in early 1955, the U.S. Air Force disclosed that the J67 also would be too late to meet the Avro schedule. At this point, the program now in effect was established - the installation of Pratt & Whitney J75s, as an interim measure, and Orenda PS13s (Iroquois) when the became available. Although the Iroquois development was well advanced, and its specifications more than met Avro's requirements, the combination of an untried engine and an untried airframe was considered not practical on an aircraft development flight test program.

From the time the basic configuration was established to the end of 1956, up to 460 engineers, technicians and draftsmen worked on the design and development of the Arrow and its systems.

Aerodynamically the Arrow was entering a new realm of science. Performance, stability and control problems were difficult to evaluate, and data had to be obtained to establish air loads on the wing, fin, canopy and control surfaces.

Analog computing equipment was installed to accelerate the solution of aerodynamic and stress problems. The company also obtained a new electronic digital computer of great speed and capacity to accommodate its accelerated research and development program in supersonic aircraft. This was the IBM 704, a giant computer equivalent in calculating and problem-solving power of 3,000 perfectly organized and trained engineers.

Supersonic aircraft also involve problems which previously could be ignored. Two such problems which required extensive investigation relate to structure weaknesses caused by heat and sound. The heat problem is caused by friction between the air and the aircraft skin. Temperatures attained while flying at supersonic speeds are high enough to weaken structure - the higher the speed, the greater the heat, the bigger the problem.

There are two main types of detrimental sound - jet engine and aerodynamic. These can cause skin panels to fracture and rivets to loosen, again weakening structure. Sonic structural tests are being carried out constantly and will continue until they have run long enough to indicate satisfactory panel life.

The hundreds of items of mechanical, hydraulic, electrical, and electronic equipment in the Arrow are all required to operate in a severe high-temperature, high-altitude environment with the utmost reliability. Equipment which would perform under these conditions did not exist when the Arrow design got under way.

Long before the first of the 17,000 engineering drawings were released to the Manufacturing Division preparations for production planning and tooling-up were already well underway.

Over 176,000 square feet of additional floor space was provided for the Arrow program. New machines, including a 15,000 ton rubber pad forming press, a big metal-to-metal bonding autoclave, a special heat treat furnace, a giant skin mill and heavy machining equipment were brought in.

The Procurement Department began negotiations which resulted in over 650 suppliers being established for the present Arrow program. As the program progressed, more than 5,000 people were found to be employed outside Avro in the manufacture of Arrow parts and tools.

Using over 1,500,000 square feet of floor space the thousands of production shop personnel have made and assembled some 38,000 parts into the first Avro Arrow. This was a giant task while still maintaining scheduled production in all phases of the CF-100 program.

In the production shops difficult machining and forming operation became the rule rather than the exception, while many major advances were made in tooling techniques and methods.

Evidence of the successful pre-planning of the Arrow program throughout the tooling up, manufacturing of parts and assembly of the completed aircraft is evident today. The Arrow was fabricated and assembled in less than two and a half years from the date of the first design release. In addition, the first Arrow's man-hours-per-pound ratio is approximately 80% of projects of similar size and complexity throughout the aviation industry in North America.

It is now four years since the design started. This is considered better than average for the time required to design and build present day high performance aircraft.

The present Arrow is on the threshold of the heat barrier, popularly called the Thermal Thicket, and studies are now under way to adapt the aircraft for even higher speeds to pierce this barrier.

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Corrections

Notes

If you have any comments, corrections, or suggestions regarding this or other Aerospace

Foundation of Canada pages, please contact Kemp Watson (kemp@watson.com) or call the A.H.F.C. in Toronto, Canada at (416)-xxx-xxxx.