

Flying Into History: The “Firsts” of the AVRO Arrow

By Matthew Wilkinson

Dates through 2007 into 2009 mark a series of 50th anniversaries for the legendary AVRO Arrow. October 4th, 2007, marked the 50th Anniversary of the Roll-out of the AVRO Arrow; March 25th, 2008, marked the 50th Anniversary of the First Flight; and looking ahead, February 20th, 2009, will mark the 50th Anniversary of the cancellation of the CF-105 Arrow program. All of these anniversaries commemorate significant milestones in the story of this famed Canadian aircraft, and we will continue looking at different aspects of its remarkable story in the Heritage News. This article will explore some of the “firsts” or technological achievements attained by the AVRO Arrow program. The program truly was innovative for the aeronautics industry, and set new directions and specifications for airplane development. In the 1950s A.V. Roe Canada emerged as an industry leader, and their greatest achievement was arguably the short-lived Arrow.

In aftermath of WWII, A.V. Roe Canada found itself in an excellent position to attract some of the best engineering minds in the world, as the end of the war saw a glut of engineers and aeronautical professionals on the international job market. A.V. Roe Canada’s first design project was to develop a jet-powered transport aircraft for Trans Canada Airlines. In April 1950, eight years before the inception of the first American commercial jet airplane, the AVRO Jetliner was born. Following on the heels of this early developmental success, AVRO Canada began to design, and ultimately develop, the CF-100 all-weather jet interceptor – an aircraft that was to become one of the most successful and longest serving military aircraft ever produced in Canada. AVRO continued to invest heavily in research and design, and each new design brought new technological innovations, which ultimately led to the design of the CF-105 or Arrow.

The RCAF stipulated that the new CF-105 had to be able to pull 2 G’s at 50,000 feet at a speed of Mach 1.5. In awarding the CF-105 program to A.V. Roe Canada, the RCAF established performance stipulations that set the stage for some of the greatest design leaps in the aerospace industry, although in many ways the aviation industry was turning its attention to supersonic flight and Arrow was a product of its time, although arguably the most advanced aircraft of its time. The Arrow was eventually pushed to Mach 1.98, flying over 2000 kilometres per hour with “Spud” Potocki at the controls, and would fly up to a height of 58,000 feet. The industry change, of which A.V. Roe was one of the industry leaders, saw the redesign of many aspects of production, right from tool and die, to alloy fabrication, to wiring and tooling. Many aspects of individual components, design, fabrication, production and assembly involved technological innovation.

That being said, many of the aviation advances that were made with the Arrow were but part of the overall maturing, international advancement and sophistication of the aviation industry, but even those involved could sense that the Arrow can to represent something more than a collection of parts that could fly. Former Chief of Air Staff Wilf Curtis explained: “In my opinion the Arrow was a product of the times. Believe it or not, it was designed conservatively, building on the available know-how. Advances were made and limits were extended. Manufacturing techniques and quality control became more exacting. Management skills and methods were learned. Thousands of people improved their abilities and pulled together. When you hear of everyday workers going into Avro early so that they could walk through the plant and see the progress of the Arrow, you can’t help but be impressed. Something special was going on in Malton during those days.”

Jack Woodman, the only RCAF pilot to fly the Arrow and the official representative of the government, reported that the aircraft performing as predicted and was meeting all specifications. The design team was confident that the Mark II Arrows, starting with RL-206 with and the

Iroquois engine, would surpass Mach 2 easily, and planned on hitting Mach 3 with future series. With the cancellation and destruction, we will never know what the aircraft could have achieved. There are some simple facts relating to the AVRO Arrow program: only five Arrows were ever flown, with each of the Mark I Arrows being powered by the J75 engine. The first Mark II Arrow, RL-206, were nearing completion when the program was abruptly cancelled by the Federal Government. RL-206 was to have been powered by the Orenda Iroquois engine, and was expected to have set new flight records. Even though only five Mark I Arrows ever flew, they set a new standard for design and flight performance expectations, and set new milestones in terms of “firsts” in the aeronautics industry:

AVRO Arrow Firsts

From “Avro Aircraft and Coldwar Aviation” by Randall Whitcombs

- First aircraft designed with digital computers being used for both aerodynamic analysis and designing the structural matrix;
- First aircraft design to have major components machined by CNC;
- First aircraft to be developed using an early form of “computational fluid dynamics” with an integrated “lifting body” theory;
- First aircraft to have marginal stability designed into the pitch axis for better maneuverability, speed and altitude performance;
- First aircraft to have negative stability designed into the yaw axis to save weight and cut drag, also boosting performance;
- First aircraft to fly-by-wire (electronic signal);
- First aircraft designed to be data-link flyable from the ground;
- First aircraft designed with computer controlled integrated navigation, weapons release, automatic search and track radar, data-link inputs, home-on-jamming, infrared detection, electronic countermeasures and counter-countermeasures;
- First high wing jet fighter that made the entire upper surface a lifting body;
- First sophisticated bleed-bypass system for both intake and engine/exhaust;
- First by-pass engine design. (all current fighters have by-pass engines).
- First use of Titanium for significant portions of the aircraft structure and engine;
- First use of a drooped leading edge and aerodynamic “twist” on the wing;
- First use of engines at the rear to allow both a lighter structure and significant payload at the centre of gravity;
- First use of a long internal weapons bay to allow carriage of specialized, long-range standoff and cruise missiles;
- First integration of ground-mapping radar and the radar altimeter plus flight control system to allow a serious strike and reconnaissance role. The first to propose an aircraft be equally adept at those roles while being the air-superiority fighter at the same time;
- First missile armed aircraft to have a combat weight thrust to weight ratio approaching 1 to 1;
- First flying 4,000 psi hydraulic system to allow for lighter and smaller components;
- First oxygen-injection re-ignition system;
- First engine to have only two main bearing assemblies on a two-shaft design;
- First to use a variable stator on a two-shaft engine;
- First use of a trans-sonic first compressor stage on a turbojet engine;
- First “hot-streak” type of afterburner ignition.

For more information on the technological “Firsts” of the AVRO Arrow, please visit:
www.kaap.purpleglen.com/avroarrow.html & www.avroarrow.org/AvroArrow/arrowfirsts.html
or see: “The Arrow Scrapbook” by Peter Zuuring.