Aeronews

QinetiQ's specially-modified Harrier guided itself in to precise hover from 30 miles (48km) out.

STOVL Harrier Recovery

When the short take-off and vertical landing (STOVL) variant of the Joint Strike Fighter comes into squadron service with the US Marine Corps and UK Royal Navy, a major requirement will be for it to operate from aircraft carriers in poorer weather conditions than is possible with the existing BAE Systems Sea Harrier and Boeing AV-8B. Qinetiq, formerly part of the UK Defence Evaluation and Research Agency last year claimed the world's first automatic recovery of a STOVL aircraft to a moving platform. This followed 85 deck landings on the UK aircraft carrier Invincible earlier in the year to check the aircraft's control laws on the moving deck of a ship. The "ship" in this case was a vehicle moving at vessel speed along the runway of Boscombe Down airfield in sourthern England. Qinetiq's VAAC Harrier was flown to a point 48km out, where the pilot commanded the guidance system to generate a recovery trajectory back to the predicted 'ship' rendezvous point. Flying fully hands-off, the VAAC Harrier descended through the controlled airspace around Boscombe Down, decelerated, then took up hover position alongside the 'ship' within five seconds of the predicted time of arrival. The demonstration brought together several areas of technology, including advanced flight control (to stabilize the aircraft and provide high performance autopilot capability), sensor integration techniques and covert datalink technologies.

Members Matter

Here we are again, *the last column of the year. You will probably, like me, say: 'Where in the world did the time go?' I guess, as a person matures, time seems to accelerate down the runway of life.*

First of all, I want to thank you for your support for AHFC, suggestions and offers of articles of the glory days of Canadian aviation. I remember talking with a friend of mine, and recall what he said: "Sometimes we cannot see the forest for the trees." At first, I thought he was trying to be funny. But when I thought about it later, he was making a point. Often we talk about the great interceptor, the Arrow, with pride and appreciation.

Yet we tend to overlook the many individuals at Avro, whose combined individual contributions made the Arrow's first flight a reality. You can't have a majestic forest without the trees. That's why we try to feature individual contributions, and highlight their skills and ingenuity. That's why we feature such articles, so that we may remember; and that others may learn. We need to document this information, so that young people know what Canadians did so well. We will also include, from time to time, interesting old and new 'stuff'. Watch for more of the same next year in Pre-Flight!

With the year end *just around the corner, tax receipts for donations are up to date. As last year, they will have been issued and are on their way, along with gifts for general donations.*

I wish to extend a special 'thank you' and much appreciation to those, who have always responded to membership renewals, as well as general donations. Some have even done so ahead of time! This has made it so much easier for me to fulfill my duties as Director responsible for Membership. I said it last year, and now say it again, that it has been and is always a joy to receive your ongoing comments and suggestions. They too are appreciated and I 'taken under serious advisement'. Please keep them coming: write or phone or fax, whichever is more convenient.

Accompanying this newsletter will be your 2003 renewal and donation form with some minor changes. Please read it carefully, as we have limited stock for gift selection.

I wish each and every member health, happiness, love and peace this Christmas Season and in the coming New Year.

Nicholas Doran

Nicholas Doran, Membership

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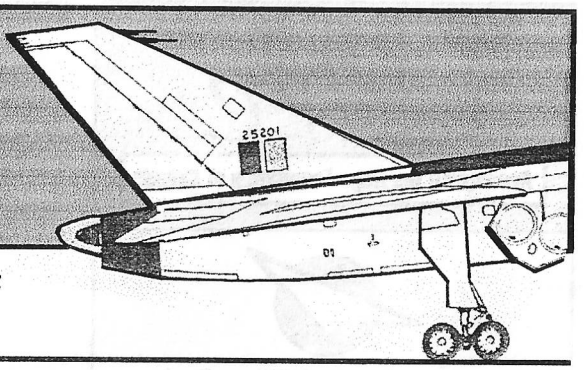
Pre-Flight



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PRODUCING THE ARROW *FREE-FLIGHT MODEL* WINGS

by John Kershaw
AHFC Member No. 380

John Kershaw

John ran a machine shop, Keicher Engineering, in Kitchener, from 1953. The shop became a major sub-contractor to Avro on both the CF-100 and the Arrow. The firm machined many components that were used on the Arrow, and was involved in designing innovative tools, necessitated by the requirements for a supersonic rather than a conventional aircraft. At the time, few machine tools existed that could do the job. Because of the expertise developed while machining important components for the Arrow, this experience created an open door to the market in U.S.A. after Black Friday.

The Keicher Engineering Company in Kitchener had been a supplier to the AVRO Aircraft Company for several years on the CF-100 Program. I was the General Manager during the 1950s and 1960s. The Company had established a reputation as a reliable sub-contractor to AVRO during this period. We manufactured critical items such as high strength steel, attachment fittings for attaching the wings to the fuselage, plus various sculptured components.

In 1955, we were asked by AVRO Purchasing, if we were interested in machining eight one-eighth scale model wings for the new Canadian Fighter Aircraft. In as much as we had just purchased a large vertical milling machine with a hydraulic copying attachment which was ideal for this type of work. We accepted the offer. We were given rough drawings of the wings with basic dimensions but no co-data. We were advised the co-ordinates would have to be held to a tolerance of plus or minus five thousands of an inch. We submitted a bid for the job with the understanding that AVRO would supply the raw materials.

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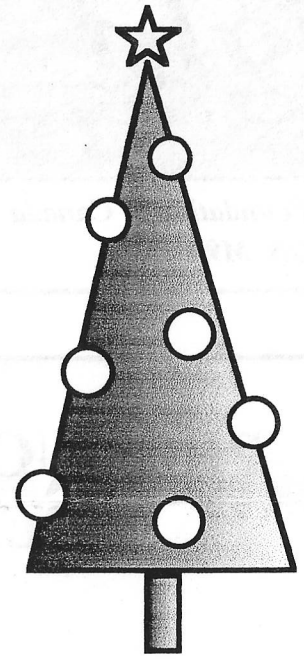


From the Vice-President

As Vice-President, I am writing this message as Ian is presently undergoing therapy treatments. I am sure that we all wish him a speedy recovery. On behalf of Ian, myself and all your Board of Directors, we wish all members and their families a very Merry Christmas and a Happy, Prosperous New Year.

Frank Harvey
Vice-President, AHFC

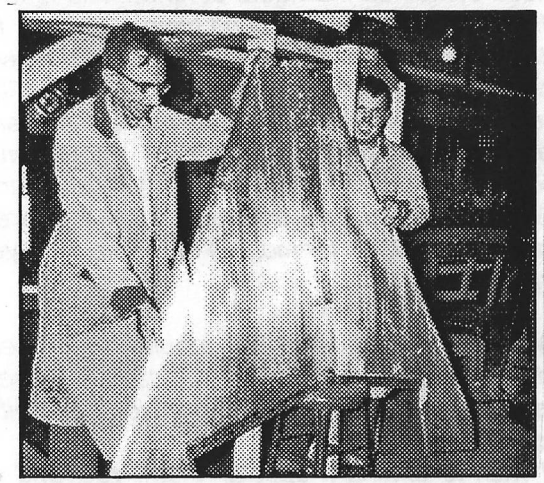
Wings, *cont'd.*

The raw material was a block of magnesium alloy. While Purchasing accepted our bid, the AVRO engineering department stated they did not believe our company had the capability to produce the parts to the required tolerance. They wanted the contract to be placed with a company in Boston Massachusetts, United States of America (U.S.A.). This company had produced similar wings for a U.S. aircraft company. AVRO Purchasing wanted to place the business in Canada if possible. After much discussion a compromise was made. The order would be split four to each company. However the Boston company would receive an option for four more if Keicher failed to deliver acceptable parts.

We received a purchase order and proceeded to plan the machining. Some modifications were necessary to our milling machine to increase its range in order that we could machine the full length of the wing at one pass. We then requested the complete dimensional data including the co-ordinates for the wing cords. At this point, we met another major problem. We were visited by security personnel from AVRO plus the Royal Canadian Mounted Police (R.C.M.P.) officers. We were advised that only Canadian citizens or British subjects could perform the work due to the highly classified nature of the program. In addition, there would be background checks on the selected personnel in order to give them security clearance. At that time 90% of our staff were not Canadian citizens, most of them had come over from Europe at the end of the war. After much discussion, a compromise was agreed on. The machining could be performed by non-Canadians, but they could not have access to the dimensional information. In addition a separate area must be closed off to provide space for pattern manufacturing, inspection and final finishing of the wings. Only security cleared personnel would be allowed in this area. We agreed to this and provided a list of personnel to receive security clearance. At this point we received all the dimensional data and proceeded with the job. →

Wings, *cont'di*

The first job was to produce machining patterns of the wings. Four patterns were required, upper and lower for each wing. The wing dimensional data consisted of three cords one at the fuselage, one at the centre of the wing and one at the wing tip. The dimension's of the cords were given in X and Y co-ordinates. Straight line geometry connected the cords. In order to produce the patterns, we made templates in thin metal of each cord. These were laid out and hand filed to the correct X and Y co-ordinates. We then mounted them on to a large machined plate at the correct wing location. The space between the templates was then filled in with a special plaster of paris. After hardening, the plaster was dressed to provide the straight line geometry between the cord templates. This was the method used by all aircraft companies at the time to provide master models of the actual aircraft shapes.



As the pattern construction was underway the wing design was modified adding a notch and a drooped leading edge. We then built holding fixtures for both the patterns and the parts. Tooling holes were bored into the holding fixtures and patterns for location. The blocks of raw material were then machined flat and tooling holes were bored in excess material to fit the machining fixtures. Once the set up was made on the machine the tooling holes allowed us to remove the patterns and parts, and replace them without losing location. The machining fixtures were now mounted on the milling machine. The patterns and parts were now fitted and machining commenced. A one inch ball end milling cutter was used to machine the contour of the wing. As the machine table moved the tracing unit followed the pattern shape and the cutter produced the same shape on the wing material. After each pass the table was moved in steps until the complete wing surface was machined. We found it necessary to machine each side of the wing three times, turning the part over after each cycle. This was necessary to prevent warpage due to stress in the raw material.

After the final machining cycle 90% of the raw material had been removed to produce a finished wing. At this point the wing surface resembled a fine plowed field. The bottom of the grooves being the correct wing contour and the peaks were surplus materials. The wing was now hand dressed to a smooth surface. Inspection of the wing cords now followed, using a height gauge and a special dial indicator set up. Any discrepancy discovered was corrected by hand dressing. This was slow work, but it was necessary to ensure the finished wing met the required tolerances. At this point a further engineering change was made. The engineers decided the drooped portion of the wing from the wing notch to the wing tip should be produced as a detachable item. As this was a critical area of the wing, it was felt if changes were required as a result of tests, a new modified detail could be fitted without the need to dismantle the wing. This change was not incorporated in the first wing.

After the wing at this stage had passed inspection the fuselage end of the wing had to be machined to produce the negative slope of the wing. Known as negative dihedral. This slope on the Arrow was four degrees. The final machine operation was to machine a deep slot at the back of the wing to provide space for the movable elevators. The AVRO engineers had designed an ingenious method of moving the elevators in flight within this limited space.

After this the tooling hole lugs were cut off. The two wings were then fitted together and held by metal plates on the upper and lower surfaces. At this point we had a finished wing. We also machined all of the vertical tail units following the same procedure. All of our items were accepted by AVRO inspection on receipt. We also received an order for two additional wings, out of the eleven wings used in the tests, six were produced by Keicher Engineering.

These were exciting days for the Canadian Aircraft industry. It isregrettable it had to come to an abrupt end. ***JK***