

COPY OF ORIG LETTER
FROM KEN CARLINE
AVRO-UK-IN GEORGIA
1988-RELATED TO UK
IN 1953

ROUTE 2, Box 166

ELLABELL TL 104-97/10

GA. 31308. COVER
LETTER

1/MAR/97

Recd 7/MAR/97

OCT/1997 VIA L.S.W.

Dear Les,

It was nice to hear from you again and I trust you are keeping well & not working yourself too hard. The information you enclosed brought back happy memories of my time with AVRO & the work we did together with John Frost and Des Earl back in 1953. I can say categorically that the Initial Projects Group were involved with the Project 'Y' team and with the idea of using multiple Soars (same as RB108) engines in a fan-like manner within the same platform as the one with the single, large radial flow engine. It's conceivable that when the Avro Canada group returned to Malton they concentrated on a number of alternate ideas as reflected in the P.17 of GEN/S 2 1/2 section 4 (Summary of Aircraft Designs) which includes all their Project Numbers. These were not our Avro numbering system and not on the same sized paper as our IPD reports which were foolscap as will be seen in the pages of Sections 1 and 2. (Bottom of page & bit of top cut off in Xerox machine)

Since the RB108 (or "Soar" as it was later called) was about 2000 lb thrust, then 20 of these would have been 40,000 lb. thrust and as I recall the Project 'Y' radial flow engine was about this thrust & the T.O. weight about 35,000 lb. The twin-engine Avro 724 had a total of $21,800 \text{ lb} \times 2 = 43,600 \text{ lb}$. thrust at S.L. with the two RB 106 engines. This made the two projects comparable and it's a great pity that you don't have Section 3 which shows a comparison which I am sure was done by Peter Robinson and Bert Eldridge of my group. You will see the date of July 1953 (7/53) on the various pages was, the period that I was in charge of Initial Projects (1951-54) and does not have an Aerodynamics Department N

so it did not originate with Peter Sutchcliffe's group (Aerodynamics). We in I.P.D. only put our number on the leading page and the cover. I know that sounds odd but that's the way it was. Also, the IPD alone gave each project the number (ie Avro 720, 724 etc) although there were a number of separate schemes worked on which never got a number and the 20-RB108 engined version of Project 'Y' was one of these. Among others were a lift-engined version of the Avro 707B research aircraft (it had 4-RB108's in addition to the RR 'Derwent' propulsion engine). Also, a VTOL bomber with 100-RB108 engines lifting that Peter Bradshaw* worked on and did a lot of performance work but the idea was dropped. Some people at Avro thought the whole idea of VTOL was ridiculous and we were often discouraged by this attitude. I sent a memo in 1947 to Harold Rogerson (Chief Technician) saying we should pursue VTOL and that if lift engines could be 10 to 1 (Engine Thrust $\div$ Engine Weight) T/W it could be made to work. He said such an idea was preposterous and threatened to sack me but he didn't. Of course later versions of the RB162 and others were even better, approaching $T_e/W_e \approx 20$. He was one of the old stagers and although a solid stressman, knew little of engine technology. [* This was reported in I.P.D. Report 178.]

Incidentally, the RB106 engine was the Rolls-Royce answer to the "Troquois" for supersonic fighters and bombers and we used it in our studies of future supersonic bombers but of course nothing ever came of these and the engine was not pursued much further. An interesting feature was the use of water injection for increasing cruise thrust and cruise altitude rather than for increasing take-off thrust. The only engine then developed for supersonic use was the Bristol B.O.1.7 "Olympus" which was eventually used in the design of "Concorde". Both these engines were contemporary. [See I.P.D. Report 179 "Design of Supersonic Bombers" by A.J.K. Carline] [February 1954.]

(later) I have just been 'rooting' through some of my old documents and have discerned one interesting point. All I.P.D. reports have the date written in the boxes at the lower left hand side of the page, using only the month and year (e.g. 7/53) whereas the Aerodynamics Dept. reports have the dates

written in the boxes using the day, month and year (e.g. 24/2/53) or (24-2-53). This confirms to me that the Avro 724 / Project 'Y' reports you sent me were originated by the Initial Projects Dept. In fact, the writing of the date is suspiciously like mine! But I can't remember if I wrote the report or not. If we could find Section 3 I think it could solve the dilemma. Peter could have written a more detailed report later, after I had left Avro in August 1954 (Friday 13th it was), but one could ask, why leave this for over a year when nothing more was being done at Chadderton on this project. I don't think you will find any report, as I don't think there was one.

Have you tried Jim Floyd for information or any of the Project 'Y' people that are still around? The page 17 of Gen/S & C/2 being an AVRO CANADA document, it seems reasonable that some of these people or Peter Martin would know something. Alternatively, why not try the U.S. Army/Air Force who co-sponsored the VZ-9V Avrocar in 1955.

Well, Les I think I have exhausted all the obvious avenues and I'm sure something will surface to help your quest for information on the Project 'Y'.

Keep in touch and let me know how things develop and if I come across anything else I will send it to you.

Best regards to you + the family.

Sincerely

Ker.

(A.J.K. CARLINE)

Avro 720

COPY OF ORIG AVRO UK
KEN CARLINE WRITEUP
OF AVRO UK PROJECTS

This was the

when I took ^{set} ~~1947/1948~~ ^{Des L.}

OR (Operational Requirement) for an interceptor which was required to climb from sea level to 60,000 ft. in under 3 minutes, intercept an intruding aircraft and destroy it, and return to base and make a dead-stick landing. There were other requirements for airfield basing and manoeuvrability but the rapid climb was the prime requirement. Multiple rockets were to be the armament in some sort of retractable "egg-box" container. The power plant was to be a rocket motor and at the time two candidates were being developed. One was the Armstrong Siddeley "Screamer" utilising Liquid Oxygen as the oxidant and Kerosene the fuel; the other was the de Havilland "Snarler" which used HTP (High Test Peroxide) and Kerosene. Both engines were about 8,000 lb thrust at sea level (slightly more at 60,000 ft.) and were throttleable for varying thrust. The proposals had to be submitted by about March 1952 but before this time the Ministry altered the specification to include a separate turbojet to give the aircraft more flexibility by allowing a 2 hour "storge" at 40,000 ft. on the jet, then a rapid climb to 60,000 ft in less than 1 minute plus acceleration to supersonic speeds (top speed $M=2.2$) then a descent with the jet alone followed by a normal landing. The armament was also changed to include a pair of 'Firestreak' infra-red homing missiles (heat seekers) pylon mounted, one under each wing.

Our proposal included studies of both rocket engines together with a single Armstrong-Siddeley 'Viper' turbojet as an interim measure. Later versions would have the de Havilland Gyron Junior (8,000 lb. S.L. thrust) giving it a thrust to weight of ~~was~~ ^{about} 1.0 with the rocket engine since the aircraft weighed

I supervised as Head of Initial Projects
October 1951. It started with an

Auro 720

AS HEAD OF INITIAL

SET/1992/1A des. W. J. The Projects

This was the first project that I supervised when I took over this job in October 1951. It started with an OR (Operational Requirement) for an interceptor which was required to climb from sea level to 60,000 ft. in under 3 minutes, intercept an intruding aircraft and destroy it, and return to base and make a dead-stick landing. There were other requirements for airfield basing and manoeuvrability but the rapid climb was the prime requirement. Multiple rockets were to be the armament in some sort of retractable "egg-box" container. The power plant was to be a rocket motor and at the time two candidates were being developed. One was the Armstrong Siddeley "Screamer" utilising Liquid Oxygen as the oxidant and Kerosene the fuel; the other was the de Havilland "Snarler" which used HTP (High Test Peroxide) and Kerosene. Both engines were about 8,000 lb thrust at sea level (slightly more at 60,000 ft.) and were throttleable for varying thrust. The proposals had to be submitted by about March 1952 but before this time the Ministry altered the specification to include a separate turbojet to give the aircraft more flexibility by allowing a 2 hour "stooze" at 40,000 ft. on the jet, then a rapid climb to 60,000 ft in less than 1 minute plus acceleration to supersonic speeds (top speed $M=2.2$) then a descent with the jet alone followed by a normal landing. The armament was also changed to include a pair of 'Firestock' infra-red homing missiles (heat seekers) pylon mounted, one under each wing.

Our proposal included studies of both rocket engines together with a single Armstrong Siddeley 'Viper' turbojet as an interim measure. Later versions would have the de Havilland Gyron Junior (8,000 lb. S.L. Thrust) giving it a thrust to weight of ~~over~~ ^{about} 1.0 with the rocket engine since the aircraft weighed

about 17,000lb. fully loaded. The Exon Junior would also confer better subsonic performance without the rocket. We preferred the liquid oxygen/kerosene aircraft because of the better specific impulse, but on the negative side the boil-off of the cryogenic LO_2 at -297°F compared with the non-cryogenic nature of HTP was a problem for aircraft at readiness. To achieve a low structure weight of less than 20% of the gross weight, AVRO developed an aluminium honeycomb capability including a machine to manufacture the honeycomb core. 85% of the structure was honeycomb sandwich construction including most of the fuselage, wing and vertical stabilizer. The aircraft was a tailless 60° swept delta configuration with a 4% thick wing into which the whole landing gear was retracted without any external excrescences whatsoever. Operational empty weight including armament was 8,051.5lb which with 9,763.0lb of 'fuel' gave a take-off weight of 17,814.5lb. Interestingly, this aircraft had almost identical performance (ie T.O Weight) to the F-16 Fighting Falcon except it was 20 years ahead in time and could actually fly much higher but had less subsonic range.

There were, I believe, 13 proposals submitted by all the major aerospace companies in the U.K. (at that time there were about 22 companies) but Avro with the 720 and Sanders-Roe with their HTP/Kerosene proposal won the competition to build aircraft. Avro were told to design the LO_2 /kerosene version so that there could be a comparative evaluation of the two different propellants. In the event, both were overtaken by reheat developments and the next interceptor to be developed was the 'English Electric' Lightning (F3/49). The Sanders-Roe aircraft did fly and the Avro 720 very nearly got there but later both were cancelled, the 720 in the infamous Duncan Sandys era of 1956. Before this happened, several versions of the Avro 720 were projected including the following:-

AVRO 725 - Advanced Trainer

This version utilised the basic layout of the 720 wing, fuselage and tail unit but added a second tandem seat where the LO_2 tank was located, removed the rocket engine and had either a single de Havilland P535 or ~~Avro~~ ^{Bristol B.F.24} turbojet. With the lower weight resulting from the removed rocket and LO_2 fuel the 8,000lb. thrust jet still gave excellent performance in the subsonic and low supersonic range. The project was initiated in November 1953.

Avro 726 - Lightweight Fighter

Another version projected at the same time as the Avro 725 (Nov. 1953) featured a single seat inexpensive, single engine fighter, again using mostly 720 structure. The preferred engines were either the PS35 or the Armstrong Siddeley AS-P151 turbojets. This aircraft had good subsonic manoeuvre-ability and some low supersonic capability and was intended for 'third world' sales, like the MIG-21 and Northrop F-5.

Avro 727 - Ground Attack Aircraft

In late 1953, NATO issued a specification for a high subsonic ground attack aircraft and AVRO responded with a version of the 720, but using a single Bristol 'Ophion' turbojet and loaded with armament (rockets and bombs etc). I went several times to NATO headquarters (then in Paris) and we had a very good candidate, but it was obvious that they wanted to build up the German and Italian aircraft industry. As a result the Fiat G-91 aircraft, designed from scratch but also using the 'Ophion' engine was chosen and was built in Germany (by Dornier) and Italy and I believe kits were made in several other countries of NATO.

Avro 728 - Navy Version

This version was developed in March 1955 after I had left AVRO to join Fairchild in the U.S.A. so I am not familiar with the details.

- None of the AVRO 720, 725, 726, 727 or 728 variants were related to Project 'Y', although the alternate reflected by the Avro 724 did utilise the wing planform and thickness of the ~~720~~ 720 but with a clipped tip to reduce span from 27.3 ft. to 24 ft.
- The Avro 720 proposal consisted of two volumes each 3" thick and for about 6 weeks we in the Project Office spent night and day in shifts preparing all the fold-out drawings and typewriter script.