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Meeting to Discuss CF-105 Problems
Held December 20 and 21, 1954
at
National Advisory Committee For Aeronautics
1512 H Street, Northwest, Washington, D. C.

Introduction

A meeting was held at NACA Headquarters on December 20 and 21, 1954, between Canadian officials, representatives of A. V. Roe (Canada) Ltd., and NACA staff members to discuss technical problems in connection with the CF-105 airplane design. The following were in attendance:

Abbott, Ira H. - Headquarters, National Advisory Committee for Aeronautics (Chairman)
Ames, M. B., Jr. - Headquarters, National Advisory Committee for Aeronautics (part time)
Armstrong, A. W. - Squadron Leader, Royal Canadian Air Force
Chamberlin, J. A. - A. V. Roe (Canada) Ltd.
Crowley, John W. - Headquarters, National Advisory Committee for Aeronautics (part time)
Dobranski, J. Stalony - A. V. Roe (Canada) Ltd.
Dryden, Hugh L. - Headquarters, National Advisory Committee for Aeronautics (part time)
Floyd, J. C. - A. V. Roe (Canada) Ltd.
Foottit, H. R. - Group Captain, Royal Canadian Air Force
Frick, Charles W. - Ames Aeronautical Laboratory, NACA
Gilchrist, A. W. R. - Defence Research Board
Green, J. J. - Defence Research Board
Lindley, R. N. - A. V. Roe (Canada) Ltd.
Lucas, J. H. - A. V. Roe (Canada) Ltd.
MacPhail, D. C. - National Aeronautical Establishment, Canada
Morris, J. - A. V. Roe (Canada) Ltd.
Pearson, E. O. - Headquarters, National Advisory Committee for Aeronautics (part time)
Plant, J. L. - Vice Marshal, Royal Canadian Air Force
Smye, F. T. - A. V. Roe (Canada) Ltd.
Templin, R. J. - National Aeronautical Establishment, Canada
Toll, Thomas A. - Langley Aeronautical Laboratory, NACA
Whitcomb, Richard - Langley Aeronautical Laboratory, NACA
Woodward, F. A. - A. V. Roe (Canada) Ltd.
Wyatt, D. D. - Lewis Flight Propulsion Laboratory, NACA

…erlin was later responsible for all of the …ering of NASA's Project Mercury and …, and collaborrated with Bob Lindley …) in the design of the Gemini Spacecraft.

…t on to lead SST design and …anced projects, including space …ems, at Hawker Siddeley in …land (etc.)

McDonnell team on …emini Spacecraft, later major involvement with …lo and the Shuttle, and …ld run the NASA Goddard …tute and be involved in …ounding of the European …e Agency and their SpaceLab.

…hief of Performance on Arrow, …ame at Hawker Siddeley APG with Floyd on SST (etc) designs, …ater went to the USA in a similar …osition.

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The following paragraphs summarize the discussion.

Drag

It was basically agreed that, in line with the area distribution curves at Mach 1.5 submitted by AVRO, and provided that (a) the intake and ramp bleed area is investigated and cleaned up where necessary, and (b) the afterbody is well faired in after the nozzles, the zero lift drag at Mach 1.5 may be as low as .020. This value may be approached by further model investigations. The AVRO estimate from area distribution and skin friction considerations was .0184. The configuration is considered to be generally reasonable with regard to drag.

Wing

Positive Camber

It was agreed that there is little to be gained by conical positive camber for the particular mission of this aircraft, i.e. Mach 1.5 at 50,000 feet, and there might be some loss of maximum supersonic speed. It was agreed, however, that to get the maximum flexibility in the aircraft, it would be a good thing to provide structurally for the possible future application of positive camber at the leading edge in case the emphasis shifted from the supersonic mission to a long-range type of mission, provided that the structural penalties are not too severe. AVRO's reasons for going to negative camber were also understood and appeared reasonable.

Pitch-up

It was agreed that the notch or leading edge extension proposed by AVRO should alleviate pitch-up, and that there would be a drag increment of between .001 and .002 at supersonic speeds to be added to the above estimate.

Intakes

It was generally agreed that the amount of diffusion and the diffusion angle involved at the intake were not excessive. AVRO pointed out that if tests later showed that a parallel section of duct was necessary to provide stabilization, this could be done without extensive structural modification.

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The problem of intake instability was agreed to be difficult and even vicious, and this required extensive test work prior to flight since it could have catastrophic effects in flight.

Stability

It was generally agreed that while artificial lateral stabilization is undesirable in itself, the obvious aerodynamic cures such as a large increase in fin area could be unacceptable so far as performance of the aircraft is concerned. A concentrated test program was recommended to explore aerodynamic means of providing lateral stability, particularly fin and rudder effectiveness.

It was particularly suggested that AVRO examine the effect of low directional stability. AVRO is doing a dynamic analysis. It was recommended that five degrees of freedom should be examined since the state of the art has now reached a point where the dynamic behavior of aircraft cannot be predicted from a cursory examination of the configuration and derivatives. AVRO agreed and is checking those areas of the flight envelope which are considered to be critical. It was noted that problems of this type are not peculiar to the CF-105 configuration but appear to be associated with the mass distributions of modern high performance fighters.

Ira H. Abbott
Assistant Director for Research
National Advisory Committee for Aeronautics

12/22/54

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JOINT PAPER produced after Avro's engineers visit NACA to discuss their earlier, harsh, condemnation of the Arrow design.

…ugh Dryden chaired, the NASA Dryden Flight Research Centre at Edward's Air Force base is named after him. Jack Ames was also there, and the NASA Ames Research Centre is named after h im.
…r. Richard Whitcomb was there, and he had invented the "area rule" theory, and later the supercritical wing. Avro's Jim Chamberlin had an excellent understanding of the concept, and the Arrow wing was …ctually a supercritical airfoil, the negative camber being designed to reduce trim drag, just as the underside curve of Whitcomb's much later supercritical airfoil did.

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