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### JOINT REPORT ON AN RCAF-DRB-NAE VISIT TO N.A.C.A. LANGLEY LABORATORIES TO DISCUSS AERODYNAMIC PROBLEMS OF AVRO CF-105 AIRCRAFT - 19 NOVEMBER 1954

#### SUMMARY

N.A.C.A. comments on CF-105 design problems are summarized as follows:

Avro's estimate turned out to be conservative.

(a) The Company's estimate of zero lift drag at subsonic and supersonic speeds should be increased by 50 percent or more.

The Arrow conformed exceptionally well to this theory in fact Avro was ahead of the US.

(b) Substantial reductions in drag throughout the supersonic speed range should be possible by proper application of the area rule.

(c) Present intake lip design is likely to result in prohibitive drag penalties at supersonic speeds.

It turned out to be the best intake design at the time, and the F-4 Phantom was modified to use one virtually identical to the Arrow... right down to the ramp and diffusion angles.

(d) The high drag due to lift associated with low aspect ratio delta wings makes them poor planforms for high endurance and long range.

(e) The high drag due to lift is not improved by the negative camber proposed by the firm. Correctly designed positive camber should be used to reduce substantially both drag due to lift and trim drag.

Was incorporated to reduce trim drag, which is what Dr. Whitcomb, present at these meetings, later realised when he "invented" the supercritical wing. The Arrow had one in 1957!

(f) A wind tunnel programme would be required to develop the means proposed by A.V. Roe to ensure intake stability.

(g) The CF-105 wing planform is of the type which gives serious pitch-up tendencies. Cures developed in wind tunnels do not always work out in flight.

(h) The directional stability characteristics of the CF-105 are poorer than had been experienced in the United States. A wind tunnel programme should be pursued.

(i) All steps should be taken to ensure aerodynamic stability before resorting to electronic means.

(j) It is possible that the use of elevons rather than separate elevators and ailerons would result in lower trim drag and higher reversal speed.

Not true since Avro planned to add aileron trimming to the fly by wire system and be able to trim the wing across-span with speed range, not just longitudinally.

Cured by negative camber inboard and droop outboard, plus the notch and saw-tooth on the leading edge.

Not true, the F-102 was worse, and REQUIRED a non-redundant tube technology directional stabilization system.

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