BLOCKAGE AND DRAG

Mumbo Jumbo # 133 by the Glue Guru
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In choosing a prototype for scale modeling we feel uneasy about the choice between draggy configurations. Obviously anything encumbered by radiators, bombs, guns, fuel tanks, etc. will provide extra drag serving to hold down endurance. At issue is: how much? Will that extra bit of blockage ruin everything?

Good tests in this area are rare. NACA meant well, but their basic output of data was aimed at full scale designers, and not really applicable to our needs. One series of truly useful tests was run by MIT back in the days of the Great War *[FLIGHT;* Sept. 13, 1917; p.946]. Here wind tunnel engineer Alexander Klemin was interested in the effect of blockage on wing performance, as given by the resulting L/D ratio.

This ratio describes the drop in altitude per unit of horizontal traverse. For example, if in glide, the wing altitude drops one foot for every ten feet of horizontal movement, the L/D is ten; if half a foot of drop for every ten feet of motion, the L/D is twenty and so on. For most of the wings we use, twenty is a very respectable, desirable number.

For test purposes, he used a rectangular 18 inch span, 3 inch chord size wing, carved to a section rather like the flat bottomed Clark-Y that most of us use. To this he added a high drag block, simulating a radiator, some 2 inches long and 3/8 inch square. At all times it was placed against the flow, with its long dimension parallel to that of the wingspan.

For test purposes, he mounted the block at a number of spots. These included:

(A) on the top surface at 20% chord back from the leading edge;

(B) on the top surface at 80% chord back from the leading edge.

(C) on the bottom surface at 80% chord back from the leading edge.

(D) on the bottom surface at 20 % chord back from the leading edge.

With the block screwed on, he proceeded to run classic wind tunnel L/D tests, varying angle of attack while measuring lift and drag. For our purposes, the maximum value he obtained for each of the A,B,C, and D configurations is a good index to performance.

With no block at all - just the bare wing - he got 17, which is pretty good. Going to (A), the resulting maximum was 6, which is terrible. The (B) setup offered a max of 11; that of (C) equaled 13; and so did (D)— it offered the same value of 13.

What can we conclude? Blockage effect varies according to the location of the block. All wing blockage lowers wing efficiency, but that placed on the top surface is much more detrimental than the same block located on the lower surface. However, if a radiator must be placed on top, try to locate it towards the trailing edge.

Best is location on the lower surface. Here, results don't depend on fore and aft positioning. You can put that radiator just about anywhere down under and the resulting L/D should still supply a decent glide.