WHERE MAX AIRFOIL THICKNESS ?

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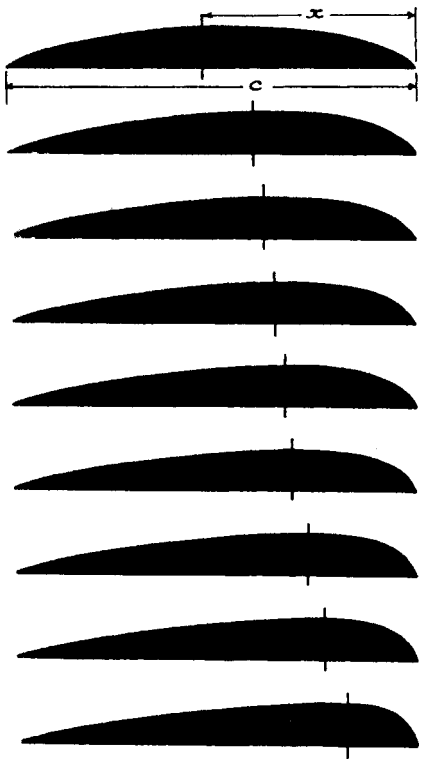
Our airfoils tend to have a flat bottom and a curved upper surface. The upper contour helps our cause by neatly accelerating air passing over the top. We control the acceleration by choosing the position of maximum section thickness. If the onset of wing thickness is too blunt, resulting in too abrupt an acceleration, there is a tendency to stall out at low angles of incidence. Too gentle an acceleration results in more drag than necessary, and a corresponding lower lift/drag ratio, meaning an inferior glide ratio.



The sketch (above) illustrates the various approaches to the issue of max thickness location. Imagine the wing sections shown in silhouette to be flying towards the right. Towards the bottom we have the blunt nose type. At the top we have the slow acceleration, or gentle rise type. We can convert the rate of rise into numbers by taking the distance along chord C at which the airfoil reaches maximum thickness and calling it X, and then working up the ratio X/c. For the sketch at the very bottom the ratio is 0.17 and that at the top equals 0.50. Which is best? This issue pushed British wind tunnel workers into testing each and every one of the silhouetted wing sections back in 1912. While the result hardly qualifies as the last word, the tunnel seems good and the test wind speed of 30 feet/sec not that far removed from FAC reality. Using as standards (1) the highest possible lift coefficient, and (2) the best value of Iift/drag, the best overall result went to those airfoils located in the middle of the sketch. The winner had a max thickness located at about the 1/3 chord point. There is nothing new in the above result; FAC has been flying airfoils of the winning type for a long time. However, new to me is the extent by which the

winner beats the loser. . The gentle 0.50 airfoil and the blunt O. I7 share an almost identical lift/drift ratio, while the best or 0.33 airfoil is some 20% better. The difference is meaningful. In terms of maximum lift, the blunt airfoil peaks at a lift coefficient of 0.8; the gentle at 1.3 and the optimum at about 1.2. All in all, go with a max thickness at 0.33 chord!

(Data from: Gt. Brit. Tech Rept. Adv. Comm. Aero. Year 1912-1913 Tech. Rept. # 72)