The fuselage contour should be such that excessive local velocities are avoided and that a smooth pressure drop occurs even with large incidence or yaw angles. Examples may be found in R & M 2204. A. D. Young A "family of streamline bodies. . ."

When the front portion of the fuselage is completely smooth and impervious one can attempt to maintain laminar flow over the removable part of the canopy. The greatest chance of this is achieved if the joint is as far back into the region of larger critical-roughness heights as possible. By using a splined connection on the front and lower joints it is probable that the smooth outer contours can be maintained even in everyday use. It may even be possible to seal the joint by this means. In the region of the largest cross-section, the pressure is of the order of 10 to 20% lower than the stagnation pressure and, as a result, flow out of the cockpit will occur through all unsealed portions, causing immediate transition to turbulent flow in the boundary layer. (In earlier World Championships one often saw canopies sealed with sealing tape from the outside. This method cannot be regarded as a solution to the sealing problem even if the roughness height of the layer is sub-critical, as it makes exit for the pilot more difficult.)

It will be difficult to maintain laminar flow over the rearward joint, firstly because of the pressure distribution, and secondly one has to allow for temperature expansion of the perspex. Despite this one should on no account allow leakage to occur at this rearwards joint because of the critical wing-root region following. One should seek a solution with an elastic seal.

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If one follows the most easily achieved concept of a smooth and impervious fuselage front region, with a resulting laminar flow up to the wing region, one naturally has to subordinate the ventilation to this aim. The air supply could be taken from the fuselage side under the wing aft of the transition region with the aid of a diffuser or a scoop and passed through flat channels to the cockpit and allowed to flow along the inside of the canopy through slits. The waste air is allowed, for practical reasons, to pass down the fuselage and exit in the region of the tail skid through a special opening.

In the same manner one is not allowed to take the total-pressure reading from the front portion of the fuselage. The pitot tube itself should consist only of a tube open to the front and having wall thickness small in comparison to the bore. Many possibilities exist for the positioning of the probe, as the total pressure can be measured anywhere outside the boundary layer and separation regions. However, for practical reasons the possible positioning is more limited. It will get in the way during rigging if placed on the fuselage sides, damage and blockage are likely when mounted on the underside of the fuselage, whereas, if positioned a small distance from the top of the fuselage, it is likely to be in a separated-flow region. One reasonable position, as sometimes chosen, is on the tip of the fin, as long as delay times are reduced by the use of small-bore tubing. Sufficiently fast response is usually obtained with tubing of approximately ⅛-inch diameter.

The static holes can also be situated with the pitot probe (pitot-static probe). Simpler, however, are holes situated about one tailplane chord in front of the tailplane. Four or more holes should be used round the periphery of the fuselage in the form of a cross with axes at 45° to the vertical. If these holes are interconnected the average static pressure measured is virtually independent of the angle of the flow to the fuselage.

If one has been able to delay transition up to the wing one can, without hesitation, think of the second possibility of drag reduction. One reduces the fuselage cross-section and thereby reduces the area subjected to turbulent flow. At the same time this fits in with a useful boundary-layer principle, namely, that one applies the major part of a pressure increase, which, after all, follows from a reduction in area, in the region of a boundary layer that has just become turbulent. One can rapidly reduce the fuselage area to values limited by rigidity criteria for fuselages with retractable undercarriages as long as one takes care with smooth fairing into the tapering rear section. It is more difficult to achieve an optimum fuselage shape for a fixed-undercarriage sailplane as the wheel drag is increased by a fuselage contraction.

Naturally these considerations can only be followed in their entirety when a new design is being conceived. In an existing aircraft one has to compromise.

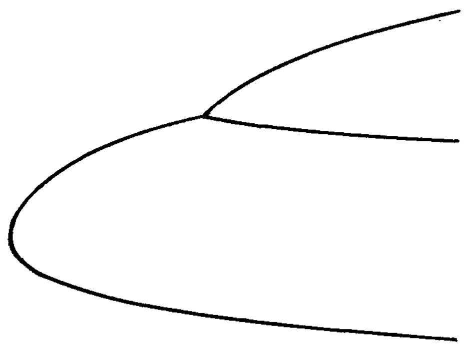

Figure 14

In a K-6 for example, it is worthwhile building a smooth and impervious nose, but there would be no point in changing the ventilation because a turbulent vortex originates from the re-entrant angle between the canopy and fuselage. It is similarly rewarding to provide fairings in front of, and round the sides of the wheel. Wind-tunnel tests have shown that the drag of a half-sunken unfaired wheel for an aircraft with the characteristics of the K-6 is $C_d=5.0\times10^{-4}$. This sinks to 3.8×10^{-4} with use of a small fairing and to 2×10^{-4} when a primitive downstream fairing which starts with the full wheel cross-section is used.

To conclude, one still occasionally sees vertical aerials growing out of the top of the fuselage. Their drag is about that of half an elevator.

TAIL UNIT

The profile for a vertical surface consisting of fin and rudder should be chosen such that transition occurs shortly before the rudder. As with ailerons, one has to seal the gap carefully. It has become common to choose very thin profiles for elevators with a relative thickness of 6 to 9%. With these thin sections the profile shape plays a minor role as far as drag is concerned. One exception, however, does occur with the all-moving tail. In this case a profile with transition occurring a long way back, such as, for example, the