



# **Critical pressure coefficient and component of local Mach number normal to the surface isobar for a swept wing**

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CRITICAL PRESSURE COEFFICIENT AND COMPONENT OF LOCAL MACH NUMBER NORMAL TO THE SURFACE ISOBAR FOR A SWEPT WING

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## CRITICAL PRESSURE COEFFICIENT AND COMPONENT OF LOCAL MACH NUMBER NORMAL TO THE SURFACE ISOBAR FOR A SWEEP WING

### 1. NOTATION AND UNITS

|                |                                                          | <i>SI</i> | <i>British</i> |
|----------------|----------------------------------------------------------|-----------|----------------|
| $C_p$          | pressure coefficient                                     |           |                |
| $C_{p_{crit}}$ | critical pressure coefficient                            |           |                |
| $c$            | wing chord                                               | m         | ft             |
| $M_n$          | component of local Mach number normal to isobar          |           |                |
| $M_0$          | free-stream Mach number                                  |           |                |
| $x$            | chordwise distance aft of section leading-edge           | m         | ft             |
| $\gamma$       | ratio of specific heat capacities (taken as 1.4 for air) |           |                |
| $\Lambda_i$    | local isobar sweep                                       | degree    | degree         |
| $\Lambda_0$    | leading-edge sweep                                       | degree    | degree         |
| $\Lambda_1$    | trailing-edge sweep                                      | degree    | degree         |

### 2. NOTES

In the analysis of measured pressure distribution data on a swept wing at high speeds it is often required to establish those areas over which supercritical flow exists and to identify the location and strength at the wing surface of any shock waves that might occur in the flow. These features are governed by the distribution over the wing surface of the component of local Mach number normal to the isobars.

In such an analysis it is convenient to relate the measured pressure distribution, at perhaps several spanwise stations, to the equivalent pressure distribution in two-dimensional flow. For a finite tapered wing the establishment of an equivalence law relating three- and two-dimensional pressure distributions is a complex problem but Derivation 1 suggests that an approximation which may be made to resolve the difficulty is to suppose that simple-sweep theory may be applied locally. At any point on the wing surface the local isobar makes an angle of  $\Lambda_i$  with the normal to the free-stream direction and it is assumed that locally the relationship between the component of Mach number normal to the isobar ( $M_n$ ) and the pressure coefficient  $C_p$  is the same as that for an infinite yawed wing of sweep  $\Lambda_i$ . The latter is in turn equivalent to a two-dimensional section with pressure coefficient  $C_p \sec^2 \Lambda_i$  at a free-stream Mach number of  $M_0 \cos \Lambda_i$ . (These expressions apply, strictly, to zero incidence but may be applied more generally, see Section 3.) Then, making use of the isentropic relationship between Mach number and pressure coefficient, the