

MOLLIER CHART OF THE THERMODYNAMIC PROPERTIES OF ARGON-FREE AIR IN DISSOCIATION EQUILIBRIUM: $T = 2\,000\text{ K}$ TO $T = 13\,000\text{ K}$

1. NOTATION AND UNITS

		<i>SI</i>	<i>British</i>
a	speed of sound	m/s	ft/s
i	specific enthalpy	J/kg	ft lbf/slug
p	static pressure	N/m ²	lbf/ft ²
R	gas constant	J/kg K	ft lbf/slug K
s	specific entropy	J/kg K	ft lbf/slug K
T	temperature	K	K
Z	real gas factor, $p/\rho RT$		
ρ	density	kg/m ³	slug/ft ³

Constants for argon-free air used in this Item

a_0	=	332.0 m/s, 1089 ft/s
p_0	=	$1.013 \times 10^5\text{ N/m}^2$, 2117 lbf/ft ² ($1.013 \times 10^6\text{ dyne/cm}^2$, 76 cm Hg)
R_0	=	288.3 J/kg K, 3103 ft lbf/slug K ($6.886 \times 10^{-2}\text{ cal/g K}$)
T_0	=	273.16 K
ρ_0	=	1.288 kg/m^3 , $2.498 \times 10^{-3}\text{ slug/ft}^3$

2. NOTES

The Mollier chart gives values of speed of sound ratio, a/a_0 , pressure ratio, p/p_0 , density ratio, ρ/ρ_0 , temperature, T , and real gas factor, Z , as functions of dimensionless enthalpy i/R_0T_0 and entropy s/R_0 . It is assumed that the air is in dissociation equilibrium and that the perfect gas laws apply to each component.

The most complete set of data available is that reported in Derivation 2. This consists of interpolations made by the Avco-Everett Research Laboratory in the data of Derivation 1. The Avco-Everett Research Laboratory made these unpublished interpolations available to the Royal Aeronautical Society for the purpose of drawing the Mollier Chart.

With the exception of speed of sound, all the data have been obtained from Derivations 1 and 2 where the air is regarded as a mixture of nitrogen and oxygen in the ratio 0.788:0.212. Speed of sound data were obtained from Derivation 3 where the air is considered as a mixture of nitrogen, oxygen and argon in the ratio 0.781:0.209:0.01.

That the omission of argon, carbon dioxide and neon from the air considered in this Item gives rise to negligible errors is shown by comparison with the results of Derivation 4 which include the effects of the three components.

A small-scale reproduction of the Mollier chart in which the variables are presented at extended intervals is presented in Figure 1. A full-scale chart (1 m × 0.7 m) is available on request from ESDU.

The thermodynamic properties of air at temperatures below 2 000 K may be obtained from Item No. Aero 00.01.12.

Examples in the use of the Mollier chart are given in Item No. Aero S.00.03.27.

3. DERIVATION

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| 1. | HILSENATH, J.
BECKETT, C.W. | Tables of thermodynamic properties of argon-free air to 15,000°K. Arnold Engineering Development Center, tech. Note-56-12, 1956. |
| 2. | FELDMAN, S. | Hypersonic gas dynamic charts for equilibrium air (including unpublished tabulated data). Avco-Everett Research Laboratory, 1957. |
| 3. | LOGON, J.G.
TREANOR, C.E. | Tables of thermodynamic properties of air from 3,000°K to 10,000°K at intervals of 100°K. Cornell Aeronautical Laboratory Rep. BE-1007-A-3, 1957. |
| 4. | HILSENATH, J.
KLEIN, M.
WOOLLEY, H.W. | Tables of thermodynamic properties of air including dissociation and ionization from 1,500°K to 15,000°K. Arnold Engineering Development Center tech. Rep.-59-50, 1959. |