

3. Engine Component Operation: Ambient Conditions

Ambient conditions include:

- flight conditions;
- atmospheric conditions.

Flight conditions are determined by

- **flight velocity**, that can be specified by value of

$$V_{f.h}, \frac{\text{km}}{\text{h}}$$

or

$$V_f = \frac{V_{f.h}}{3,6}, \frac{\text{m}}{\text{s}}$$

or

$$M_f = \frac{V_f}{a_0} \text{ - flight Mach number.}$$

- **flight altitude** H_f , km .



Atmospheric conditions include the parameters of the atmospheric air:

- **pressure** p_0 , Pa;
- **temperature** T_0 , K;
- **relative humidity** φ_d , %.

Relative humidity affects the composition and properties of atmospheric air. In thermodynamic calculations the humidity is only relevant in marine engine applications (marine engines, carrier-based aircraft and helicopters).

At Given p_0 and T_0 the density of air ρ_0 , and the speed of sound a_0 can be calculated by the expressions

$$\rho_0 = \frac{p_0}{287 \cdot T_0}, \frac{\text{kg}}{\text{m}^3};$$

$$a_0 \approx 20 \cdot \sqrt{T_0}, \frac{\text{m}}{\text{s}}.$$

If atmospheric conditions are unknown at the GTE calculations, the relative humidity is assumed to be zero, and the pressure and temperature of atmospheric air depend on the flight altitude according to the table of International Standard Atmosphere.

International Standard Atmosphere (ISA, ISO 2533:1975)

H , km	T , K	p , kPa		H , km	T , K	p , kPa
0	288.16	101.325		11	216.77	22.700
1	281.65	89.876		12	216.65	19.399
2	275.15	79.501		13	216.65	16.580
3	268.66	70.121		14	216.65	14.170
4	262.17	61.660		15	216.65	12.112
5	255.68	54.048		16	216.65	10.353
6	249.19	47.218		18	216.65	7.565
7	212.70	41.105		20	216.65	5.529
8	236.22	35.652		22	218.57	4.048
9	229.73	30.801		24	220.56	2.972
10	223.25	26.500		25	221.55	2.549

The standard consists of a tabulation of values at various altitudes, and some formulas by which those values were derived.