

**VOLUME I
PERFORMANCE FLIGHT TESTING**

**APPENDIX A
SYMBOLS
TERMS AND ABBREVIATIONS**

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SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
a	Acceleration	ft/sec ²
a	Lift curve slope	per deg or per rad
a	Speed of sound	ft/sec, mi/hr, kts
ac	Aerodynamic center	
A	Area	ft ² , m ²
AR	Aspect ratio	
b	Wingspan	ft, m
	Blade Width	ft, m
B	Number of blades	
BHP	Brake horsepower	
B.L.	Base line	
c	Absolute velocity	
c	Chord	ft, m
C	Compression	
C	Specific fuel consumption	lb/hr
°C	Degrees centigrade	deg

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC</u> <u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
C_r	Root chord	ft, m
C_t	Tip chord	ft, m
C_p	Specific heat at constant pressure	btu/lb °R
C_v	Specific heat at constant volume	btu/lb °R
C_d	Section drag coefficient	
C_f	Skin friction coefficient	
C_l	Section lift coefficient	
C_m	Section moment coefficient	
C_F	Force coefficient	
C_D	Aircraft drag coefficient	
C_L	Aircraft lift coefficient	
$C_{L_{ic}}$	Indicated lift coefficient	
C_M	Aircraft moment coefficient	
C_p	Pressure coefficient	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
C_P	Propeller power coefficient	
C_Q	Propeller torque coefficient	
C_T	Propeller thrust coefficient	
cg	Center of gravity	
cp	Center of pressure	
CR	Compression ratio	
CPR	Compressor Pressure ratio	
d	Differential	
D	Diameter	ft
D	Drag	lb
D	Diffuser	
d/dt	Time rate of change	
$dC_L/d\alpha$	Lift curve slope	per deg or per rad
e	Oswald's efficiency factor	
E	Shear modulus	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
E	Endurance	hr
E	Total energy	ft lbs
E_m	Maneuver energy	ft lbs
E_s	Specific energy	ft
EGT	Exhaust gas temperature	deg
f	Function of	
f	Equivalent flat plate area	ft^2
F	Force	lb
F	Fan	
F	Resultant aerodynamic force	lb
$^{\circ}F$	Degrees Fahrenheit	deg
F_g	Gross thrust	lb
F_n	Net thrust	lb
F_{ex}	Excess thrust	lb
F.R.L	Fuselage reference line	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC</u> <u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
F.S.	Fuselage station	
g	Acceleration due to gravity	ft/sec ²
G	Gravitational constant	32.17405 ft ² /sec ² geo- potential ft
h	Enthalpy	btu/lb
h	Tapeline altitude	ft
h _v	Kinetic energy	
H	Total head pressure	lb/in ²
H	Combustor	
H	Altitude, general	ft
H	Geopotential at a point	geopotential ft
H _c	Pressure altitude	ft
H _i	Indicated altitude	ft

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
H_{ic}	Indicated altitude corrected for instrument error, $H_{ic} + \Delta H_{ic}$	ft
ΔH_{ic}	Altimeter instrument correction	ft
H_{ic_l}	Indicated altitude corrected for instrument and lag errors, $H_i + \Delta H_{ic} + \Delta H_{ic_l}$	ft
ΔH_{ic_l}	Altimeter lag correction	ft
ΔH_p	Altimeter position error corresponding to ΔP_p	ft
ΔH_{pc}	Altimeter position error correction	ft
HP	Horsepower	hp
H.V.	Heating value of hydrocarbon fuel	btu/lb
I_s	Specific impulse	sec
J	Propeller advance ratio	
K_n	A constant	
K_t	Temperature probe recovery factor	
$^{\circ}K$	Degrees Kelvin	deg

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
KE	Kinetic Energy	
l	Characteristic length	ft
ln	Natural logarithm	
L	Lift	lb
L	Length, dimensional analysis	
L	Standard lapse rate -1.98 °C/1000 ft	deg/ft
m	Slope of a line at a point	
m	Mass	slug
mac	Mean aerodynamic chord	
M	Mass, dimensional analysis	
M	Mach, flight or free stream	
M_i	Indicated Mach	
M_{ic}	Indicated Mach corrected for instrument error, $M_i + \Delta M_{ic}$	
ΔM_{ic}	Machmeter instrument correction	
ΔM_p	Machmeter position error corresponding to P_p	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
ΔM_{pc}	Machmeter position error correction	
M	Moment	ft lb
MAC	Mean aerodynamic chord	
n	Load factor	
n	Number of stages	
N	Nozzle	
N	Revolutions per minute	
NACA	National Advisory Committee for Aeronautics	
NASA	National Aeronautics and Space Administration	
N_{pr}	Prandtl number	
P	Power	hp, ft lb/sec
P	Pressure, general	lb/in ²
P	The applied pressure at a point at a time, t	in Hg
P_a	Atmospheric pressure corresponding to H_c	in Hg

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
$P_{a_{sl}}$	Atmospheric pressure at standard sea level	2116.22 lb/ft ² 29.92126 in Hg
P_i	The indicated pressure at a point at a time, t	in Hg
ΔP_p	Static pressure error or position error	in Hg
P_s	Pressure corresponding to H_{ic}	in Hg
P_s	Specific Excess power	
P_t or P_T	Free stream total pressure	in Hg, lb/in ²
P'_t	Total pressure at total pressure source	in Hg
PE	Potential energy	ft lb
q	Dynamic pressure, $\rho V_T^2/2$	in Hg
q_c	Differential pressure, $P'_t - P_a$	in Hg
q_{cic}	Differential pressure corresponding to V_{ic} , $P'_t - P_s$	in Hg
Q	Heat or heat energy	btu
Q	Torque	in lb

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
r	Blade length	in, ft
R	Radius of turn	
R	Range	
R	Gas constant for dry air	$\text{ft}^2/\text{sec}^2 \text{ } ^\circ\text{R}$
$^\circ\text{R}$	Degrees Rankine	deg
R_e	Radius of the earth	ft
R_e	Reynolds Number	
RF	Range factor	
ROC	Required operational capability	
ROC	Rate of climb	
RW	Relative wind	
s	Specific Entropy	btu/lb
s	Distance	ft
S	Total wing or planform area	ft^2
S_a	Air distance	ft

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
S_g	Ground roll distance	ft
SM	Stall margin	
SR	Specific range	nam
SFC	Specific fuel consumption	
SPR	Stage pressure ratio	
t	Thickness	in, ft
t	Time	sec
t_a	Atmospheric temperature	$^{\circ}\text{C}$
t_{as}	Standard day atmospheric temperature corresponding to H_c	$^{\circ}\text{C}$
t_{asl}	Standard sea level atmospheric temperature	15°C
t_{at}	Test day atmospheric temperature	$^{\circ}\text{C}$
t_i	Indicated temperature	$^{\circ}\text{C}$
t_{ic}	Indicated temperature corrected for instrument error, $t_i + \Delta t_{ic}$	$^{\circ}\text{C}$
Δt_{ic}	Air temperature instrument correction	$^{\circ}\text{C}$

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
T	Temperature	deg
T	Time, dimensional analysis	
T	Turbine	
T	Propeller thrust	lb
T_a	Atmospheric temperature	$^{\circ}\text{K}$
T_{as}	Standard day atmospheric temperature corresponding to H_c	$^{\circ}\text{K}$
T_{asl}	Standard sea level atmospheric temperature	288.16°K
T_{at}	Test day atmospheric temperature	$^{\circ}\text{K}$
T_i	Indicated temperature	$^{\circ}\text{K}$
T_{ic}	Indicated temperature corrected for instrument error, $T_i + \Delta T_{ic}$	$^{\circ}\text{K}$
ΔT_{ic}	Air temperature instrument correction	$^{\circ}\text{K}$
T_t	Total temperature	$^{\circ}\text{K}$
T_T	Total temperature (general)	deg

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC</u> <u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
TE	Total energy	
THP	Thrust horsepower	
TIT	Turbine inlet temperature	deg
TPR	Total pressure ratio	
TSFC	Thrust specific fuel consumption	lb/hr
u	Linear velocity	ft/sec
V	Velocity or true airspeed	
V_c	Calibrated airspeed, $V_i + \Delta V_{ic} + \Delta V_{pc}$	kts
V_e	Equivalent airspeed, $V_c + \Delta V_c$ or $V\sqrt{\sigma}$	kts
V_i	Indicated airspeed	kts
V_{ic}	Indicated airspeed corrected for instrument error, $V_i + \Delta V_{ic}$	kts
ΔV_{ic}	Airspeed indicator instrument correction	kts
V_{ic_l}	Indicated airspeed corrected for instrument and lag errors, $V_i + \Delta V_{ic} + \Delta V_{ic}$	kts

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>ARABIC</u> <u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
ΔV_{ic_l}	Airspeed indicator lag corrections	kts
ΔV_p	Airspeed indicator position error corresponding to ΔP_p	kts
ΔV_{pc}	Airspeed indicator position error correction	kts
ΔV_c	Compressibility correction	kts
V_s	Standard day true airspeed	kts
V_t	Test day true airspeed	kts
w	Relative velocity	ft/sec
w or W	Work	ft/lb
w	Downwash velocity	ft/sec
W	Aircraft gross weight	lb
\dot{w}_a	Airflow rate	lb/hr or lb/sec
\dot{w}_f	Fuel flow rate	lb/hr or lb/sec
W.L.	Water line	
X	Distance	ft
z	Energy reference height	ft
\propto	Proportional to	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
α	Angle of attack	deg, rad
β	Angle of sideslip	deg
β	Bypass ratio	
γ	Ratio of specific heats	
γ	Flight path angle	deg
δ	Pressure ratio , $P_a/P_{a_{sl}}$	
δ_{ic}	$P_s/P_{a_{sl}}$	
δ_L	Laminar boundary layer thickness	
δ_T	Turbulent boundary layer thickness	
δ	Wedge angle or turning angle	
Δ	Change in any quantity	
ϵ	Axial strain	
ϵ	Downwash angle	deg, rad
η	Efficiency	
η_o	Overall efficiency	
η_p	Propulsive efficiency	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
η_{th}	Thermal efficiency	
θ	Temperature ratio, $T_a/T_{a_{sl}}$	
θ_s	$T_{as}/T_{a_{sl}}$	
θ_t	$T_{at}/T_{a_{sl}}$	
θ	Shock wave angle	
λ	Lag constant	sec
$\lambda_{H_{ic}}$	Lag constant corresponding to H_{ic}	sec
λ_s	Static pressure lag constant	sec
λ_{sl}	Lag constant at standard sea level	sec
$\lambda_{s_{sl}}$	Static pressure lag constant at standard sea level	sec
λ_t	Total pressure lag constant	sec
$\lambda_{t_{sl}}$	Total pressure lag constant at standard sea level	sec
λ	Taper ratio	
λ	Sweep angle	deg

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
μ	Coefficient of absolute viscosity	lb sec/ft ²
μ	Viscosity at temperature T_a	lb sec/ft ²
$\mu_{H_{ic}}$	Viscosity corresponding to H_{ic}	lb sec/ft ²
μ_{sl}	Viscosity at standard sea level	3.7452×10^{-7} lb sec/ft ²
μ	Mach angle	deg
μ	Coefficient of friction	
ν	Kinematic viscosity	ft sec
ν	Turning angle	deg
π	3.14159 ...	
π	Buckingham π	
ρ	Air density	slug/ft ³
ρ_a	Standard day air density corresponding to H_c	slug/ft ³
ρ_{sl}	Air density at standard sea level	.0023769 slug/ft ³
ρ_t	Test day air density	slug/ft ³
σ	Density ratio, ρ_a/ρ_{sl}	
σ_s	ρ_s/ρ_{sl}	

SYMBOLS, TERMS, AND ABBREVIATIONS

<u>Symbol or Term</u>	<u>Definition</u>	<u>Units</u>
σ_t	ρ_t/ρ_{sl}	
σ	Axial stress	lb/in ²
σ	Solidity ratio	
τ	Acoustic lag	sec
τ	Shear stress	lb/in ²
ϕ	Bank angle	deg
ω	Rate of turn	deg/sec or rad/sec

SUBSCRIPTS

<u>Symbol or Term</u>	<u>Definition</u>
a	Ambient
a	Available
cr	Critical
e	Equivalent
ex	Excess
f	Final
i	Induced
i	Initial
iw	Corrected to a standard weight
L	Laminar
M	Wave
N	Normal (perpendicular)
o	Stagnation or total
p	Parasite

SUBSCRIPTS

<u>Symbol or Term</u>	<u>Definition</u>
p	Pressure
r	Required
r	Root
s	Static
s	Standard day
sl	Sea level
t	Tangential
t	Test day
T	Total
TD	Touchdown
TO	Takeoff
X	Conditions upstream of shock wave
Y	Conditions downstream of shock wave
OL	Zero lift
1,2,3, etc.	Specific condition or station

SUBSCRIPTS

Symbol or Term

Definition

∞

Free stream condition

SUPERSCRIPT

Symbol or Term

Definition

Choked condition