

**CLEARINGHOUSE FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION CFSTI
DOCUMENT MANAGEMENT BRANCH 410.11**

LIMITATIONS IN REPRODUCTION QUALITY

AD
ACCESSION # 604 223

- 1. WE REGRET THAT LEGIBILITY OF THIS DOCUMENT IS IN PART UNSATISFACTORY. REPRODUCTION HAS BEEN MADE FROM BEST AVAILABLE COPY.
- 2. A PORTION OF THE ORIGINAL DOCUMENT CONTAINS FINE DETAIL WHICH MAY MAKE READING OF PHOTOCOPY DIFFICULT.
- 3. THE ORIGINAL DOCUMENT CONTAINS COLOR, BUT DISTRIBUTION COPIES ARE AVAILABLE IN BLACK-AND-WHITE REPRODUCTION ONLY.
- 4. THE INITIAL DISTRIBUTION COPIES CONTAIN COLOR WHICH WILL BE SHOWN IN BLACK-AND-WHITE WHEN IT IS NECESSARY TO REPRINT.
- 5. LIMITED SUPPLY ON HAND: WHEN EXHAUSTED, DOCUMENT WILL BE AVAILABLE IN MICROFICHE ONLY.
- 6. LIMITED SUPPLY ON HAND: WHEN EXHAUSTED DOCUMENT WILL NOT BE AVAILABLE.
- 7. DOCUMENT IS AVAILABLE IN MICROFICHE ONLY.
- 8. DOCUMENT AVAILABLE ON LOAN FROM CFSTI (TT DOCUMENTS ONLY).
- 9.

PROCESSOR: *sm*

604223

604223



ANALYTICAL APPROXIMATIONS

Volume 11

Cecil Hastings, Jr.

James P. Wong, Jr.

P-415 ✓ *Red*

1 July 1953

Approved for OTS release

| | | | |
|------------|-----|----|---|
| COPY | 1 | OF | 1 |
| HARD COPY | \$. | | |
| MICROFICHE | \$. | | |

DDC

RECEIVED

AUG 19 1964

DDC-IRA C

The **RAND** Corporation

SANTA MONICA · CALIFORNIA

Copyright 1953
The RAND Corporation

4-15-53

Analytical Approximation

Bessel Function of Imaginary Argument: To better
than .00007 over (0,2),

$$e^{-x} J_1(x) \doteq \frac{.4981x + .0066x^2}{1 + .9805x + .4477x^2} .$$

Cecil Hastings, Jr.
James P. Wong, Jr.
RAND Corporation
Copyright 1953

4-20-53

Analytical Approximation

Bessel Function of Imaginary Argument: To better than .000,006 over (0,1),

$$e^{-x}I_1(x) \doteq \frac{.49974x - .01695x^2}{1 + .95935x + .36282x^2} .$$

Cecil Hastings, Jr.
James P. Wong, Jr.
RAND Corporation
Copyright 1953

Analytical Approximation

Bessel Function of Imaginary Argument: To better than .0005 over (0,∞),

$$e^{-x}I_1(x) \doteq \frac{x}{\sqrt{3.78 + 9.81x + 3.09x^2 + 6.36x^3}}$$

Cecil Hastings, Jr.
James P. Wong, Jr.
RANL Corporation
Copyright 1953

6-1-53

Analytical Approximation

Mach Number in Terms of Pressure Ratio: To .001 over
.3 ≤ M ≤ 1.0 the inverse of

$$x = \frac{P_s}{P_A} = \left[1 + \left(\frac{\gamma-1}{2} \right) M^2 \right]^{-\frac{\gamma}{\gamma-1}},$$

where $\gamma = 1.4$, is given by

$$M \doteq \frac{2.714 - 2.625x}{1 + 1.650x - 1.955x^2}.$$

Cecil Hastings, Jr.
James P. Wong, Jr.
RAND Corporation
Copyright 1953

6-10-53

Analytical Approximation

Bessel Function of Imaginary Argument: To better
than .00005 over $(2, \infty)$,

$$e^{-x} I_1(x) \doteq \frac{x}{\sqrt{10.281 + 3.752x + 4.541x^2 + 6.296x^3}}$$

Cecil Hastings, Jr.
James P. Wong, Jr.
RAND Corporation
Copyright 1953