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APPROXIMATE CALCULATION OF TURBULENT BOUNDARY-LAYER DEVELOPMENT IN COMPRESSIBLE FLOW By Maurice Tucker

April 1951

Page 2, line 12: Reference 2 should be reference 1.

Page 4, the line following the unnumbered equation should read as follows: "is independent of any additional Mach number dependence according to the reference-temperature"

Page 7, line 4:

$$C_{f}\left(\frac{u_{1}x}{1}\right)^{1/7}$$
 should be $C_{f}\left(\frac{u_{1}x}{v_{1}}\right)^{1/7}$

Page 7, line 3 from the bottom: N_1 should be N.

Page 8: The line preceding equation (10a) should be deleted.

Page 9: Equation (10b), the preceding line, and the following definition of J should be deleted.

Page 10: The following note should be added to the definition of r_1 : $(r_{1,a} = 0)$

Pages 11 and 12, equations (12b), (13b), and (13c): The quantities $(r_b - r_0)$ and $(r_a - r_0)$ should be $(r_{1,b} - r_0)$ and $(r_{1,a} - r_0)$, respectively.

Page 12, equations (13a) and (13c): Replace $\frac{F}{M_{b}}$ by $\frac{E}{M_{b}}$, $\frac{E}{M_{a}}$ by $\frac{F}{M_{a}}$, $\frac{J}{M_{b}}$ by $\frac{I}{M_{b}}$, and $\frac{J}{M_{a}}$ by $\frac{I}{M_{a}}$.

Page 12: Equation (14) should read

$$\frac{r_0}{r_0 - r_{1,b}} \quad \text{or} \quad \frac{r_b}{r_a} = \frac{M_a}{M_b} \left(\frac{5 + M_b^2}{5 + M_a^2}\right)^5$$

Page 12: The line following equation (13d) should read "Planar divergent or convergent flow fields may be regarded as radial flows for"

Page 13: Line 1 should read "Inasmuch as the length $r_b - r_a$ or $r_0 - r_{1,b}$ is known, the radii \dot{r}_a and r_b "

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Page 15: The following note should be added to the definition of r_1 :

$$(r_{1,a} = 0)$$

Page 21, Table II, column 7: The value 109.11741 should be 169.11741. Pages 27, 28, and 29: Table IV should be deleted.

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE 2337

APPROXIMATE CALCULATION OF TURBULENT BOUNDARY-LAYER

DEVELOPMENT IN COMPRESSIBLE FLOW

By Maurice Tucker

SUMMARY

Numerical solutions of quantities appearing in the Kármán momentum equation for the development of a turbulent boundary layer in plane and in radial compressible flows along thermally insulated surfaces are presented in tabular form for a range of Mach numbers from 0.100 to 10. Through use of these tables, approximate calculation of boundary-layer growth is reduced to routine arithmetic computation. The variation of local skin-friction coefficient with Mach number is obtained through the assumption that the Falkner relation for low-speed flat-plate friction coefficients is dependent only on Reynolds number provided that the fluid properties are evaluated at the arithmetic mean of the wall temperature and the stream temperature. The friction Mach number relation thus obtained closely follows the trend of the extended Frankl-Voishel analysis.

INTRODUCTION

Use of the Kármán momentum equation for computation of supersonic turbulent boundary-layer development essentially requires a knowledge of the effect of Mach number and pressure gradient upon the local skinfriction coefficient. The tabulations of reference 1 for obtaining the boundary-layer development along thermally insulated surfaces were based on two extreme assumptions as to the Mach number effect. The assumptions may be described as follows. Falkner's empirical low-speed relation for the local turbulent skin-friction coefficient of a flat plate (reference 2) can be written

$$\frac{\tau}{\rho u_1^2} = \frac{0.0131}{R^{1/7}}$$

where

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local skin-friction stress

o density

u, velocity at outer edge of boundary layer

R Reynolds number based on distance from start of boundary-layer development

The nondimensional ratio $\tau /\rho u_1^2$ is taken to be dependent only on Reynolds number provided that the density and the kinematic viscosity are evaluated at some reference temperature in the boundary layer. The static-pressure gradient normal to the wall or bounding surface is taken as zero for the boundary-layer region. The two assumptions of reference 2 are obtained by selecting as a reference temperature the stream temperature and the wall temperature, respectively. With stream temperature as the reference, the local skin-friction coefficient $\tau /\rho_1 u_1^2$ (where ρ_1 is the density at the outer edge of the boundary layer) becomes independent of Mach number. An extreme variation of $\tau /\rho_1 u_1^2$ with Mach number that is almost identical with the variation suggested by von Kármán in reference 3 is obtained by evaluating the fluid properties at the wall temperature.

The Frankl-Voishel analysis of reference 4, based on von Kármán's formulation of the mixing length, predicts a variation of local skinfriction coefficient with Mach number for zero pressure-gradient flow that is less severe than the variation obtained by use of wall temperature as a reference. The final results of reference 4 are limited to the subsonic Mach numbers because of the series expansions used to integrate in quadrature. This limitation is avoided in reference 5 by use of numerical integration to obtain, for constant free-stream Reynolds number of 7×10^6 , the reduction of mean friction-drag coefficient with Mach number shown in figure 1.

Experimental data on turbulent friction-drag coefficients in supersonic flow under action of zero pressure gradient are not yet adequate to establish the effect of Mach number upon friction drag. The variation of flat-plate mean friction-drag coefficient with Mach number given by the extended Frankl-Voishel analysis appears compatible with the experimental trends given in reference 5.

As shown herein, selection of the arithmetic mean of the wall temperature and the stream temperature as a reference temperature leads to a friction-drag Mach number relation that is both in substantial agreement with the extended Frankl-Voishel relation and amenable to boundary-layer calculation. This report presents the tabulations required for approximate computation of compressible turbulent-boundarylayer development based on selection of the arithmetic-mean temperature as the reference temperature. These tabulations were made at the NACA Lewis laboratory.

ANALYSIS

Physical Assumptions

The following analysis is essentially that of reference 1 with the modifications required to incorporate the new assumption regarding the local skin-friction coefficient. The wall or bounding surfaces are considered to be thermally insulated and the effective Prandtl number is taken as unity. The stream stagnation temperature and the wall temperature are thus equal. The energy equation

$$c_{p}t + \frac{u^{2}}{2} = constant$$

is then assumed to be applicable to turbulent boundary-layer flow. The ratio of specific heats γ is taken as 1.40, independent of temperature. (All symbols are defined in the appendix.)

From the assumptions of constant static pressure and constant stagnation temperature along any section normal to the wall in the boundary layer and through use of the perfect gas law, the boundarylayer density ratio is given as

$$\frac{\rho}{\rho_{1}} = \frac{1}{m^{2} \left[\frac{1+m^{2}}{m^{2}} - \left(\frac{u}{u_{1}} \right)^{2} \right]}$$
(1)

With the use of the definition for arithmetic-mean temperature $t_{am} \equiv \frac{1}{2} (T_w + t_1)$, the density ratio ρ_{am} / ρ_1 is obtained from equation (1) as

$$\frac{\rho_{\rm am}}{\rho_1} = \frac{2}{2+m^2} \tag{1a}$$

The local skin-friction coefficient is

$$\frac{\tau}{\rho_{1}u_{1}^{2}} = \frac{\tau}{\rho_{am}u_{1}^{2}} \frac{\rho_{am}}{\rho_{1}} = 0.0131 \left(\frac{\nu_{am}}{u_{1}x}\right)^{1/7} \frac{\rho_{am}}{\rho_{1}}$$
(2)

Inasmuch as the quantity

$$\frac{\tau}{\rho_{am} u_{l}^{2}} = 0.0131 \left(\frac{v_{am}}{u_{l} x}\right)^{1/7} = \frac{0.0131}{R_{am}}$$

is independent of Mach number according to the reference-temperature hypothesis, the variation of the local skin-friction coefficient with Mach number arises from the dependence of the density ratio $\rho_{\rm em}/c_1$

on Mach number shown in equation (la). Use of equation (2) implies that the effect of pressure gradient upon skin friction is of secondary importance. This implication is reasonably valid for favorable pressure gradients and possibly even for very moderate adverse gradients.

The mean velocity profile for a compressible turbulent boundary layer is approximated by the power-law velocity profile

$$\frac{u}{u_1} = \left(\frac{y}{\delta}\right)^{1/N} \tag{3}$$

For a constant stagnation-temperature profile, the arithmetic-mean temperature occurs at the point in the boundary layer where $\left(\frac{u}{u_1}\right)^2 = \frac{1}{2}$ or, for a power-law profile, at $\frac{y}{\delta} = \left(\frac{1}{2}\right)^{N/2}$.

An approximate guide for the variation of the velocity-profile parameter N with Reynolds number may be obtained from the rearrangement of von Kármán's logarithmic velocity-profile relation for lowspeed turbulent flow given in reference 6.

$$e^{\left(\frac{u}{u_{1}}-1\right)} = \left(\frac{y}{\delta}\right)^{\frac{1}{K}\sqrt{c_{f}}}$$
(4)

where the quantity c_f is defined as $\tau/\rho u_1^2$. For low-speed flows the density is practically constant through the boundary layer. On the

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assumption that the velocity profile is independent of Mach number, the quantity c_f is taken as $\tau/\rho_{am}u_1^2$ for this analysis. The following relation may be obtained from equations (2) to (4)

$$N = \frac{k}{\sqrt{0.0131}} R_{am} \left(\frac{\frac{u}{u_{1}} - 1}{\log_{e} \frac{u}{u_{1}}} \right)$$

Evaluating the velocity ratio arbitrarily at the point where the arithmetic-mean temperature is obtained and taking k=0.3 (reference 1) give the relation

$$N = 2.2 R_{am}$$
 (5)

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The qualitative nature of this relation should be noted. Table XI of reference 1 indicates that for favorable pressure gradients the important boundary-layer quantities θ and δ^* are not greatly influenced by the value of N selected. Lack of sufficient data even at low speeds precludes consideration of the effect of adverse pressure gradients upon either mean-velocity profiles or local skin-friction coefficients.

Treatment of Momentum Equation

By analogy with the equations derived in reference 1, the momentum equation

$$\tau = \frac{d}{dx} (\rho_1 u_1^2 \theta) + \rho_1 u_1 \delta^* \frac{du_1}{dx}$$

can be put in the form

$$\frac{d\delta}{dx} + \varphi \frac{dM_1}{dx} \delta = \frac{\rho_{am}}{\rho_1} \frac{\tau}{f \rho_{am} u_1^2} = \frac{K \psi_{am}}{x^{1/7}}$$
(6)

where

$$\varphi = \frac{g + f(2 - 7m^2) + \frac{2m^2 N}{(1 + m^2)^2} \int_0^1 \frac{s^2 (s^N - s^{N+1}) ds}{\left(1 - \frac{m^2 s^2}{1 + m^2}\right)^2}}{\sqrt{5} fm (1 + m^2)}$$

$$K = 0.0131 \left(\frac{\mu_0}{\rho_0 a_0}\right)^{1/7}$$

$$\psi_{am} = \frac{(1+m^2)^{2/7}}{\left(1 + \frac{m^2}{2}\right)^{5/7} fM_1^{1/7}}$$

With zero pressure gradient $\begin{pmatrix} dM_{l} \\ dx \end{pmatrix}$, equation (6) simplifies to

 $\frac{d\delta}{dx} = \frac{K\psi_{am}}{x^{1/7}}$

which for constant N and thus constant f has the solution

$$f\delta_{b} = \theta_{b} = \frac{7K}{6} \left[\frac{(1+m^{2})^{2}}{M_{1}\left(1+\frac{m^{2}}{2}\right)^{5}} \right]^{1/7} \left(x_{b}^{6/7} - x_{a}^{6/7} \right) + \theta_{a}$$
(7)

The subscripts a and b designate the start and end, respectively, of the integration interval.

The effect of the reference-temperature assumption upon the Mach number variation of the flat-plate mean friction-drag coefficient can now be obtained. The mean friction-drag coefficient $C_{\rm f}$ is defined as the friction drag per unit wetted area divided by free-stream dynamic pressure. For flat-plate flow, the mean friction-drag coefficient may be expressed in terms of $\theta_{\rm b}$ as

$$C_{f} = \frac{2\theta_{b}}{x_{b}}$$
(8)

where $\theta_{\mathbf{a}} = 0$.

If the temperature-viscosity relation is assumed to be $\mu_0 = \mu_1 \left(\frac{T_0}{t_1}\right)$, the friction-drag parameter $C_f \left(\frac{u_1 x}{1}\right)^{1/7} \equiv C_f R_1^{1/7}$ for

the arithmetic-mean temperature as reference temperature is obtained from equations (7) and (8) as

$$(c_{f})_{am} R_{1}^{1/7} = \frac{0.0306}{\left(1 + \frac{m^{2}}{2}\right)^{5/7}}$$
 (9a)

For the wall temperature as reference temperature, equation (8) and equation (13b) of reference 1, which corresponds to equation (7), are used to obtain

$$(C_f)_W R_1^{1/7} = \frac{0.0306}{(1+m^2)^{5/7}}$$
 (9b)

The ratio of compressible-flow to incompressible-flow flat-plate mean friction-drag coefficient is shown in figure 1 for the two referencetemperature assumptions. The variation of mean friction-drag coefficient predicted by the arithmetic-mean temperature as reference agrees very well with the modified Frankl-Voishel variation.

With the assumption, as in reference 1, that N_1 , $\frac{dx}{dM_1}$, and $x^{1/7}$

are constant for a given integration interval, the solution of equation (6) may be put in the form

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 $\int_{1}^{M_{a}} \varphi dM_{1} - \int_{1}^{M_{b}} \varphi dM_{1}$ $\delta_{M_{a}} e e e \qquad (10)$

where M_a and M_b denote the stream Mach numbers at the start and end, respectively, of the integration interval and \overline{x} denotes the mean distance of the interval from the effective starting point of boundarylayer development. In order to determine \overline{x} , the assumption is made that θ_{M_a} develops under action of a zero pressure gradient at the Mach number M_a and equation (7) is used. With subsonic flow, the

Mach number for the lower limit of integration in equation (10) is arbitrarily chosen as 0.100.

The following variations of equation (10) will be found convenient for computation of two-dimensional flows:

For favorable pressure gradients $(dM_1/dx \text{ positive})$:

$$\delta_{M_{b}} = \underline{E}_{M_{b}} \frac{K \frac{dx}{dM_{1}}}{\sqrt{1/7}} \left(\underline{I}_{M_{b}} - \underline{I}_{M_{a}} \right) + \delta_{M_{a}} \underline{E}_{M_{b}} \underline{F}_{M_{a}}$$
(10a)

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where





For adverse pressure gradients $(dM_1/dx negative)$:

$$\delta_{\mathbf{M}_{\mathbf{b}}} = \underline{F}_{\mathbf{M}_{\mathbf{b}}} \frac{K \frac{d\mathbf{x}}{d\mathbf{M}_{\mathbf{l}}}}{\frac{1}{\mathbf{x}}} \left(\underline{J}_{\mathbf{M}_{\mathbf{b}}} - \underline{J}_{\mathbf{M}_{\mathbf{a}}} \right) + \delta_{\mathbf{M}_{\mathbf{a}}} \underline{F}_{\mathbf{M}_{\mathbf{a}}} \underline{F}_{\mathbf{M}_{\mathbf{b}}}$$
(10b)

where

$$\underline{J} \equiv \int_{1}^{M} -\int_{1}^{M_{1}} \varphi dM_{1}$$
$$\underbrace{J}_{em} = dM_{1} \text{ (from table IV)}$$

Tables I, II, and V to VII are taken from reference 1.

For diverging radial flows the momentum equation can be written

$$\frac{d\delta}{dr} + \left(\varphi \quad \frac{dM_1}{dr} + \frac{1}{r}\right) \quad \delta = \frac{K\psi_{am}}{\frac{1}{7}} \tag{11a}$$

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where r designates the distance from the apparent origin of the radial flow to the point The following variation of equation (11a) is convenient for converging in question. radial flow:

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$$\frac{d\delta}{dr_1} + \left(\psi \frac{dM_1}{dr_1} + \frac{1}{r_1 - r_0}\right) \delta = \frac{K\psi_{am}}{x^{1/7}}$$
(11b)

where

- distance from start of integration interval to point in equation มา
- distance from start of integration interval to apparent sink in converging radial potential flow о н

Equations (11) involve the assumption that the local skin-friction coefficient in radial flow is identical with that for two-dimensional flow.

With the approximations used for equation (10), the respective solutions of equations (11a) and (11b) are



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where

- mean distance of interval designated by $M_{\bf A}$ and $M_{\bf b}$ from apparent source in diverging radial potential flow IH
- to apparent sink in conmean distance of interval designated by M_R and M_b verging radial potential flow $(r_1 - r_0)$

In application of equation (12), the assumption is again made that $heta_{M_{f a}}$ develops under the action of a zero pressure gradient at the Mach number M_a. With subsonic flow, the Mach number for the lower limit of integration is arbitrarily chosen as 0.100.

The following variations of equations (12) are convenient for computation of radial flows:

Subsonic flow under adverse pressure gradient ($dM_{\rm I}/dr$ negative):

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and

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$$\delta_{M_{b}} = \frac{F_{M_{b}}}{r_{b}\overline{x}} \frac{1}{7} \left(\frac{J_{M_{b}}}{r_{b}} - \frac{J_{M_{a}}}{r_{b}} \right) + \delta_{M_{a}} \frac{r_{a}}{r_{b}} \frac{F_{M_{a}}}{r_{b}} \frac{F_{M_{b}}}{r_{b}}$$
(13a)

Subsonic flow under favorable pressure gradient $(dM_1/dr positive)$:

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$$\delta_{M_{b}} = \underline{E}_{M_{b}} \frac{K \frac{dr_{1}}{dM_{1}} (\overline{r_{1}} - \overline{r_{0}})}{(r_{b} - r_{0}) \overline{x}^{1/7}} (\underline{I}_{M_{b}} - \underline{I}_{M_{a}}) + \delta_{M_{a}} \frac{(r_{a} - r_{0})}{(r_{b} - r_{0})} \underline{E}_{M_{b}} \underline{F}_{M_{a}}$$
(13b)

Supersonic flow under adverse pressure gradient $(dM_1/dr negative)$:

$$\delta_{M_{b}} = \underline{F}_{M_{b}} \frac{K \frac{d\mathbf{r}_{1}}{dM_{1}} (\overline{\mathbf{r}_{1}} - \overline{\mathbf{r}_{0}})}{(\mathbf{r}_{b}} - \mathbf{r}_{0}) \overline{\mathbf{x}}^{1/7} (\underline{J}_{M_{b}} - \underline{J}_{M_{a}}) + \delta_{M_{a}} \frac{(\mathbf{r}_{a}}{(\mathbf{r}_{b}} - \mathbf{r}_{0})}{(\mathbf{r}_{b}} - \mathbf{r}_{0})} \underline{E}_{M_{a}} \underline{F}_{M_{b}}$$
(13c)

Supersonic flow under favorable pressure gradient $(dM_1/dr positive)$:

$$\delta_{M_{b}} = \underline{E}_{M_{b}} \frac{K \frac{d\mathbf{r}}{dM_{1}} \mathbf{\bar{r}}}{\mathbf{r}_{b} \mathbf{\bar{x}}^{1/7}} \left(\underline{I}_{M_{b}} - \underline{I}_{M_{a}} \right) + \delta_{M_{a}} \frac{\mathbf{r}_{a}}{\mathbf{r}_{b}} \underline{E}_{M_{b}} \underline{E}_{M_{a}}$$
(13d)

Divergent or convergent flow fields may be regarded as radial flows for which the position of the apparent source or sink is variable. For the boundary-layer calculations, this continuous variation may be approximated as a stepwise variation. From the one-dimensional area-ratio relation, which is applicable to radial flows, the following equation results:

$$\frac{\mathbf{r}_{b}}{\mathbf{r}_{a}} = \frac{M_{a}}{M_{b}} \left(\frac{5+M_{b}^{2}}{5+M_{a}^{2}}\right)^{3}$$
(14)

Inasmuch as the length $r_b - r_a$ is known, the radii r_a and r_b are determined from the known Mach number distribution along the selected streamline.

The approximate turbulent boundary-layer development in plane and radial flows along thermally insulated surfaces can be obtained from the preceding equations. For two-dimensional flow, equations (10a) and (10b) are used for favorable and adverse pressure gradients, respectively, to obtain the variation of the boundary-layer thickness δ along the surface under consideration. Equations (13) are used to obtain corresponding results for radial flow. The various quantities needed to evaluate δ , δ^* , and θ from these equations are listed in tables I to IV and VII. Equation (7) is applicable to the case of zero pressure gradient. With the variation of the boundary-layer thickness δ for a given streamwise integration interval thus known, the local values of momentum thickness θ and of displacement thickness δ^* are calculated from the ratios f and g of tables V and VI, respectively. The free-stream Mach number distribution is known and appropriate values of the parameter N can be obtained from equation (5). Linear interpolation for M and N is within the accuracy of the various approxi-

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mations. The constant $K \equiv 0.0131 \left(\frac{\mu_0}{\rho_0 a_0}\right)^{1/7}$ length and any consistent length and any consistent system of units may be used. In engineering units the constant is written

$$K = 0.0218 \left(\frac{\mu_0 \sqrt{T_0}}{P_0} \right)^{1/7}$$
(15)

where the coefficients of viscosity, temperature, and pressure are assigned the following units, respectively: pound-seconds per square foot, degrees Rankine, and pounds per square foot. All distances are then to be expressed in feet and the boundary-layer quantities δ , δ^* , and θ obtained will be given in feet.

Comparison of Analysis and Experiment

In reference 1 a comparison is made of the calculated and measured boundary-layer growth in a Mach number 2.08 supersonic tunnel with a contour-plate width of 3.84 inches and test-section dimensions of 3.84 by 10 inches. In figure 2 of this report the calculated boundary-layer growths obtained through use of the stream, wall, and arithmetic-mean temperatures as reference temperatures are compared with the growth measured along the center line of the contour plate. In view of the

secondary flows discussed in reference 7 no comparison has been made for the side-plate development. The comparison of figure 2 favors use of the arithmetic-mean temperature as a reference. Further experimental studies are required for a decisive comparison.

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CONCLUDING REMARKS

In the absence of adequate fundamental knowledge concerning turbulent shear flows, prediction of turbulent boundary-layer growth must depend on use of the integrated equations of motion and certain assumptions regarding the mean-velocity profiles and the local skinfriction coefficient. The principal assumption for compressible flow concerns the variation of local skin-friction coefficient with Mach number. The variation predicted by the Frankl-Voishel analysis as extended for high-speed flow appears compatible with the limited experimental data available for supersonic flow.

The present method uses a friction Mach number relation that almost duplicates the extended Frankl-Voishel variation and is simple enough in form to be used for boundary-layer calculation. With the tabulations presented herein, the approximate development of a turbulent boundary layer in plane and in quasi-radial compressible potential flow along thermally insulated surfaces under action of favorable pressure gradients may be obtained through routine arithmetic computation. Inasmuch as the effects of pressure gradient upon the mean-velocity profile and upon the local skin-friction coefficient are not considered and inasmuch as reliable separation criteria have not yet been established, application of the analysis to flows under action of substantial adverse pressure gradients is open to question. It may also be noted that the tabulations were extended to a Mach number of 10 primarily as a means of obtaining at least a first approximation to the boundary-layer development. Decisive experimental verification of the predictions of the present analysis is required.

Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, Cleveland, Ohio, December 13, 1950.

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APPENDIX - SYMBOLS

The following symbols are used in this report:

- a speed of sound
- Cf mean friction-drag coefficient, friction drag per unit wetted area divided by free-stream dynamic pressure
- cf local skin-friction coefficient used in logarithmic profile relation, equation (4)
- c_p specific heat at constant pressure
- f ratio of momentum thickness to boundary-layer thickness, θ/δ
- g ratio of displacement thickness to boundary-layer thickness, δ^*/δ
 - constant based on stagnation conditions (See equations (6) and (15).)

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M Mach number

Mach number parameter, $m^2 = \frac{\gamma - 1}{2} M_1^2 = \frac{M_1^2}{5}$

velocity-profile parameter,
$$\frac{u}{u_1} = \left(\frac{y}{\delta}\right)^{1/2}$$

P stagnation pressure

- R Reynolds number based on distance from effective start of boundary-layer development
- r radial distance of line of constant Mach number from apparent source in diverging radial potential flow
- r₀ radial distance from start of integration to apparent sink in converging radial flow
- rl radial distance of line of constant Mach number from start of integration to point in question for converging radial potential flow
 - mean distance of interval designated by M_a and M_b from apparent source in diverging radial potential flow

- r_1-r_0 mean distance of interval designated by M_a and M_b to apparent source in converging radial potential flow
- s variable of integration
- T stagnation temperature
- t static temperature
- u velocity
- x distance along surface measured from effective start of boundary-layer development
- x mean distance of surface interval from effective start of boundary-layer development
- y normal distance from surface
- γ ratio of specific heats
- δ nominal boundary-layer thickness, distance from wall to point in boundary layer where velocity is approximately equal to local stream velocity

 δ^* boundary-layer displacement thickness, $\frac{1}{\rho_1 u_1} \int_0^{\delta} (\rho_1 u_1 - \rho_1) dy$

 θ boundary-layer momentum thickness, $\frac{1}{\rho_1 u_1^2} \int_0^{\delta} \rho u(u_1 - u) dy$

- μ coefficient of viscosity
- ν kinematic viscosity, μ/ρ
- ρ density

- 7 local skin-friction stress
- φ coefficient defined in equation (6)

 $\Psi_{am} \quad \text{friction parameter,} \quad \frac{(1 + m^2)^{2/7}}{\left(1 + \frac{m^2}{2}\right)^{5/7} fM_1}$

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Subscripts:

0 stagnation

1 local stream

a start of integration interval

b end of integration interval

w wall

am arithmetic mean

REFERENCES

- Tucker, Maurice: Approximate Turbulent Boundary-Layer Development in Plane Compressible Flow along Thermally Insulated Surfaces with Application to Supersonic-Tunnel Contour Correction. NACA TN 2045, 1950.
- Falkner, V. M.: A New Law for Calculating Drag. Aircraft Eng., vol. XV, no. 169, March 1943, pp. 65-69.
- 3. de Kármán, Th.: The Problem of Resistance in Compressible Fluids. Quinto Convegno "Volta", Reale Accademia d'Italia (Roma), Sett. 30 - Ott. 6, 1935, pp. 3-57.
- 4. Frankl, F., and Voishel, V.: Turbulent Friction in the Boundary Layer of a Flat Plate in a Two-Dimensional Compressible Flow at High Speeds. NACA TM 1053, 1943.
- 5. Rubesin, Morris W., Maydew, Randall C., and Varga, Steven A.: An Analytical and Experimental Investigation of the Skin Friction of the Turbulent Boundary Layer on a Flat Plate at Supersonic Speeds. NACA TN 2305, 1951.
- 6. Dryden, Hugh L.: Air Flow in the Boundary Layer near a Plate. NACA Rep. 562, 1936.
- 7. Brinich, Paul F.: Boundary-Layer Measurements in 3.84- by 10-Inch Supersonic Channel. NACA TN 2203, 1950.

TABLE I - VARIATION OF E WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N

$$\underbrace{ \int_{0.100}^{M} \varphi dM_{1} }_{E = e}$$

(a) Subsonic flow.

| Mach | Velo | Velocity-profile parameter, N | | | | | | | | |
|-------|-----------|-------------------------------|-----------|-----------|--|--|--|--|--|--|
| M | 5 | 7 | 7 9 | | | | | | | |
| 0.100 | 1.0000000 | 1.0000000 | 1.0000000 | 1.0000000 | | | | | | |
| .200 | .0966699 | .1045974 | .1092891 | .1124112 | | | | | | |
| .300 | .0251985 | .0285359 | .0305797 | .0319672 | | | | | | |
| .400 | .0099328 | .0116115 | .0126636 | .0133874 | | | | | | |
| .500 | .0049379 | .0059131 | .0065348 | .0069667 | | | | | | |
| .600 | .0028542 | .0034839 | .0038905 | .0041751 | | | | | | |
| .700 | .0018362 | .0022766 | .0025639 | .0027661 | | | | | | |
| .800 | .0012804 | .0016083 | .0018239 | .0019762 | | | | | | |
| .900 | .0009432 | .0012079 | .0013777 | .0014981 | | | | | | |
| 1.000 | .0007312 | .0009530 | .0010924 | .0011913 | | | | | | |

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TABLE I - VARIATION OF E WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER M - Continued $-\int_{1}^{M} \phi dM_{1}$

| Mach | Veloci | ty-profil | e paramet | er. N | Mach | Veloci | ty-profit | | ten V |
|---------------|------------------|------------------|------------------|---------|--------------|---------|--------------------|-----------------|---------|
| number | 5 | 7 | | 1 17 | mumber | VELOC. | | te parame | Ler, M |
| | 0 00000 | 1 00000 | 1 00000 | 1 | | 0 | 7 | | |
| 1.00 | 01732 | 1.00000 | 1.00000 | 1.00000 | 3,40 | 0.58555 | 0.61904 | 0.63006 | 0.63254 |
| 1.08 | .84675 | .85227 | 85509 | .92291 | 3.49 | .59750 | +03170 | +04281 65505 | .64516 |
| 1.12 | 78618 | .79365 | .79747 | 79973 | 3.52 | .62256 | .65821 | .66949 | .00810 |
| 1.16 | .73392 | .74297 | .74758 | .75030 | 3,56 | .63567 | .67208 | .68344 | .68537 |
| 1.20 | .68864 | .69897 | .70422 | .70730 | 3.60 | .64918 | .68636 | .69781 | .69958 |
| 1.24 | .64925 | .66063 | .66639 | .66976 | 3.64 | .66309 | .70106 | .71259 | .71420 |
| 1.28 | -61486 | .62710 | .63329 | .63689 | 3.68 | .67740 | .71619 | .72780 | .72924 |
| 1.36 | .55835 | .57191 | .57871 | .58265 | 3.72 | .69213 | .73175 | .74345 | .74470 |
| L . 40 | .53512 | .54920 | .55624 | .56028 | 3,80 | .72285 | .76421 | .77606 | .77693 |
| .44 | .51467 | .52919 | .53642 | .54056 | 3.84 | .73886 | .78111 | .79304 | .79370 |
| .48 | .49666 | .51157 | .51896 | .52317 | 3.88 | .75530 | .79848 | .81048 | .81093 |
| .52 | .48078 | .49603 | .50356 | .50783 | 3,92 | .77220 | .81631 | .82838 | .82861 |
| | .46680 | .48236 | .49001 | .49431 | 3,96 | .78954 | .83462 | .84676 | .84676 |
| .60 | .45450 | .47034 | .47809 | .48243 | 4.00 | .80735 | .85342 | .86563 | .86538 |
| . 64 | .44370 | .45980 | .46764 | .47200 | 4.04 | .82563 | .87271 | .88498 | .88448 |
| • 58 70 | 40424 | .45060 | .45852 | .46289 | 4.08 | .54439 | .89250 | .90484 | .90407 |
| .76 | 42801 | .44200 | .45059 | .45497 | 4.12 | .86364 | .91280 | .92520 | .92415 |
| .80 | .41273 | .42978 | .43790 | .44229 | 4.20 | .90361 | -95496 | .96747 | .96583 |
| . 84 | .40751 | .42479 | 43297 | .43736 | 4.24 | .92436 | .97684 | .98940 | .98745 |
| .88 | .40313 | .42063 | .42887 | .43325 | 4,28 | .94563 | .99927 | 1.01188 | 1.00960 |
| 92 | .39953 | .41726 | .42555 | .42993 | 4.32 | .96743 | 1.02224 | 1.03490 | 1.03229 |
| 96 | •39664 | .41460 | . 42295 | .42731 | 4.36 | •98976 | 1.04579 | 1.05849 | 1.05552 |
| 00 | .39442 | .41262 | .42102 | .42537 | 4.40 | 1.01264 | 1.06990 | 1.08264 | 1.07931 |
| 04 | .39282 | .41126 | .41972 | .42406 | 4.44 | 1.03607 | 1.09460 | 1.10737 | 1.10367 |
| 10 | .39160 | .41050 | .41901 | 42004 | 4.48 | 1,06007 | 1.11989 | 1.13270 | 1,12859 |
| 16 | .39140 | .41029 | .41925 | .42354 | 4.52 | 1.10980 | 1.17230 | 1.18515 | 1.18021 |
| 20 | .39196 | .41145 | .42014 | .42441 | 4,60 | 1.13556 | 1.19943 | 1.21229 | 1.20692 |
| 24 | .39298 | .41276 | .42151 | .42576 | 4.64 | 1.16191 | 1.22719 | 1.24007 | 1.23425 |
| 28 | .39446 | .41453 | .42334 | .42757 | 4.68 | 1.18888 | 1.25560 | 1.26849 | 1.26220 |
| 32 36 | 39637 39870 | .41674 | .42562 .42833 | .42982 | 4.72 4.76 | 1.21648 | 1.28467 | 1.29756 | 1.29078 |
| 40 | -40143 | 42245 | .43145 | 43560 | 4.80 | 1.27358 | 1 34492 | 1 35760 | 1 34999 |
| 44 | 40456 | 42591 | 43498 | .43910 | 4.94 | 1.30311 | 1.37592 | 1.38878 | 1.38043 |
| 48 | .40807 | .42977 | .43891 | .44300 | 4,88 | 1.33331 | 1.40772 | 1.42056 | 1.41166 |
| 52 | .41195 | .43401 | .44322 | .44728 | 4.92 | 1.36419 | 1.44023 | 1,45305 | 1.44357 |
| 56 | .41620 | .43864 | .44792 | .45194 | 4.96 | 1.39576 | 1.47347 | 1.48626 | 1.47618 |
| •60 | .42081 | .44363 | .45299 | .45697 | 5.00 | 1.42803 | 1.50745 | 1.52019 | 1.50950 |
| .64 | •42577 | .44899 | .45842 | .46236 | 5.04 | 1.46101 | 1.54217 | 1.55487 | 1.54355 |
| .68 | .43108 | .45471 | .46422 | .46812 | 5.08 | 1.49472 | 1.57766 | 1.59031 | 1.57832 |
| •72 •76 | .43674 .44275 | .46080 .46724 | .47038 .47690 | .47424 | 5.12 5.16 | 1.52916 | 1.61392 1.65096 | 1.62651 | 1.61385 |
| . 80 | .44909 | .47403 | .48377 | .48753 | 5.20 | 1.60031 | 1.68881 | 1.70126 | 1.68718 |
| .84 | .45577 | 48118 | 49100 | .49470 | 5.24 | 1.63703 | 1.72747 | 1.73983 | 1.72501 |
| .88 | .46280 | .48868 | .49859 | .50223 | 5.28 | 1.67454 | 1.76695 | 1.77923 | 1.76364 |
| .92 | .47018 | .49654 | .50653 | .51011 | 5.32 | 1.71285 | 1.80727 | 1.81945 | 1.80307 |
| .96 | .47787 | .50475 | .51482 | .51833 | 5,36 | 1.75197 | 1.84845 | 1.86052 | 1.84333 |
| .00 | .48591 | .51331 | .52347 | .52691 | 5.40 | 1,79192 | 1.89049 | 1.90245 | 1.88442 |
| .04 | -49429 50300 | .52224 | .53248 | .00000 | 5.44 | 1.55270 | 1.93341 | 1.94524 | 1.92035 |
| 12 | -50302 | .53152 | .04184 | 55478 | 5,48 | 1.87433 | 1.97722 | 1,98892 | 2 01281 |
| .16 | .52152 | .55116 | .56167 | .56478 | 5.56 | 1.96020 | 2.06759 | 2.07900 | 2.05736 |
| .20 | .53129 | .56154 | .57213 | .57515 | 5.60 | 2.00446 | 2.11417 | 2.12542 | 2.10281 |
| .24 | .54142 | .57228 | .58296 | .58588 | 5.64 | 2.04963 | 2.16170 | 2.17278 | 2.14918 |
| .28 | .55191 | .58340 | .59416 | .59698 | 5.68 | 2.09572 | 2.21020 | 2.22110 | 2.19647 |
| 26.0 | .36275 | .59489 | .60574 | .60846 | 5.72 | 2.14274 | 2.25968 | 2.27038 | 2.24471 |
| .00 | .57396 | .00677 | .01771 | .02031 | 5.76 | 2.19070 | 2.31017 | 2.32067 | 5.69395 |

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TABLE I - VARIATION OF B WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER W - Concluded

| ARAMSTAR | | concino |
|----------|-----------------------|---------|
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| | | |

| (ъ) | Supersonic | flow - | Concluded. |
|-----|------------|--------|------------|
|-----|------------|--------|------------|

| Mach | Veloci | ty-profil | e paramet | er, A | Mach | Veloci | ty-profile | parameter | r, N |
|--------|---------|-----------|-----------|---------|-------------|-----------|--------------|-----------|----------|
| number | 5 | 7 | 9 | 11 | number M | 5 | 7 | 9 | 11 |
| 5.80 | 2.23963 | 2.36166 | 2.37195 | 2.34408 | 8.20 | 7.58628 | 7.99306 | 7,96007 | 7.78500 |
| 5.84 | 2.28954 | 2.41418 | 2.42424 | 2.39523 | 8.24 | 7,72817 | 8.14271 | 8,10829 | 7.92893 |
| 5.88 | 2.34044 | 2.46774 | 2.47757 | 2.44738 | 8,28 | 7.87226 | 8.29469 | 8,25883 | 8.07509 |
| 5.92 | 2.39235 | 2.52235 | 2,53194 | 2.50055 | 8.32 | 8,01858 | 8,44904 | 8.41170 | 8.22350 |
| 5.96 | 2.44527 | 2.57805 | 2.58737 | 2.55475 | 8.36 | 8.10,10 | 8.50578 | 8.00092 | 0.01110 |
| 6.00 | 2 40024 | 2.63483 | 2.64389 | 2.60000 | 8.40 | 8.31802 | 8.76494 | 8.72454 | 8.52719 |
| 6.04 | 2.55426 | 2.69273 | 2.70150 | 2.66630 | 8.44 | 8.47120 | 8,92655 | 8,88458 | 8.68252 |
| 6.08 | 2.61034 | 2.75175 | 2.76022 | 2.72368 | 8.48 | 8.62670 | 9.09064 | 9.04706 | 8.84022 |
| 6,12 | 2.66751 | 2.81190 | 2.82007 | 2.78216 | 8.52 | 8,78457 | 9.25724 | 9.21202 | 9.00030 |
| 6.16 | 2.72578 | 2.87322 | 2.88106 | 2.84174 | 8.56 | 8,94484 | 9.42637 | 9.37948 | 9.10591 |
| A 20 | 2 78517 | 2.93571 | 2.94322 | 2.90246 | 8.60 | 9,10752 | 9.59807 | 9.54948 | 9.32776 |
| 6.24 | 2.84569 | 2.99940 | 3.00655 | 2.96431 | 8.64 | 9,27264 | 9.77237 | 9.72204 | 9.49518 |
| 6,28 | 2,90736 | 3.06429 | 3.07108 | 3.02733 | 8,68 | 9.44024 | 9,94929 | 9,59719 | 9.66511 |
| 6.32 | 2,97019 | 3.13042 | 3,13683 | 3.09151 | 8.72 | 9.61034 | 10,12886 | 10.07496 | 9.83757 |
| 6,36 | 3.03421 | 3.19779 | 3,20380 | 3.15690 | 8.76 | 9,78297 | 10.31112 | 10.25539 | 10.01258 |
| A 40 | 3 00043 | 3 96649 | 3 27203 | 3 00340 | 8,80 | 9.95816 | 10-49610 | 10,43850 | 10.19019 |
| 6.44 | 3.16586 | 3.33633 | 3.34152 | 3,29131 | 8.84 | 10.13594 | 10.68383 | 10.62432 | 10.37042 |
| 6.48 | 3.23353 | 3.40755 | 3.41230 | 3.36037 | 8.88 | 10,31633 | 10.87434 | 10,91289 | 10.55329 |
| 6.52 | 3.30245 | 3.48008 | 3.48438 | 3.43069 | 8.92 | 10.49937 | 11.06766 | 11.00423 | 10,73885 |
| 6.56 | 3.37264 | 3.55396 | 3.55778 | 3,50230 | 8,96 | 10.68508 | 11.26382 | 11,19838 | 10.92711 |
| | | | 7 67050 | | 0.00 | 10 07350 | 17 46296 | 11.39538 | 11.11812 |
| 6.60 | 3.44412 | 3,62918 | 3 70962 | 3 64942 | 9.04 | 11.06465 | 11.66481 | 11.59524 | 11.31190 |
| 6.69 | 3.59101 | 3.78379 | 3.78610 | 3.72497 | 9.08 | 11,25857 | 11.86969 | 11.79800 | 11,50847 |
| 6.72 | 3.66646 | 3,86320 | 3.86498 | 3.80188 | 9.12 | 11.45528 | 12.07754 | 12,00369 | 11,70788 |
| 6.76 | 3,74327 | 3,94405 | 3,94527 | 3,88015 | 9.16 | 11.65482 | 12.28840 | 12.21236 | 11.91015 |
| | | | | | 0.00 | 11 05 700 | 10 50070 | 10 40400 | 10 11530 |
| 6.80 | 3.82146 | 4.02636 | 4.02701 | 3.95982 | 9.20 | 11.85722 | 12.50250 | 12.42402 | 12.11002 |
| 6.84 | 3.90104 | 4.11014 | 4.11019 | 4.04089 | 9.29 | 12.27070 | 12,93934 | 12.85648 | 12.53446 |
| 6.92 | 4.06449 | 4.28220 | 4.28102 | 4.20735 | 9.32 | 12.48184 | 13,16255 | 13.07734 | 12.74851 |
| 6.96 | 4.14839 | 4.37052 | 4.36870 | 4.29277 | 9.36 | 12,69597 | 13.38893 | 13.30134 | 12.96557 |
| | | | | | | | 3.7. 63.05.7 | 17 50050 | 17 10500 |
| 7.00 | 4.23376 | 4.46041 | 4.45792 | 4.37968 | 9.40 | 12,91311 | 13.01803 | 13 75997 | 13.10070 |
| 7.04 | 4.32053 | 4.00107 | 4.54809 | 4.55804 | 9.48 | 13.35655 | 14.08747 | 13,99247 | 13.63525 |
| 7.12 | 4.49894 | 4.73961 | 4.73501 | 4.64953 | 9.52 | 13.58292 | 14.32690 | 14.22935 | 13.86475 |
| 7.16 | 4,59041 | 4.83593 | 4,83059 | 4.74259 | 9.56 | 13.81243 | 14.56967 | 14.46953 | 14.09743 |
| | | | | | | | 14 01500 | 14 07 205 | 74 77774 |
| 7.20 | 4.68347 | 4.93392 | 4.92781 | 4.83724 | 9.60 | 14.04512 | 14.91582 | 14.71300 | 14.33334 |
| 7.24 | 4.77812 | 5 13400 | 5 12727 | 5.03140 | 9.69 | 14.52015 | 15.31843 | 15,21027 | 14.81497 |
| 7.32 | 4.97230 | 5.23810 | 5-22956 | 5,13094 | 9.72 | 14.76256 | 15.57495 | 15.46403 | 15.06076 |
| 7.36 | 5,07187 | 5.34298 | 5.33358 | 5.23216 | 9.76 | 15.00828 | 15,83500 | 15.72128 | 15.30992 |
| | | | | | | | 34 00003 | 15 0000F | |
| 7.40 | 5.17313 | 5.44962 | 5.43935 | 5.33508 | 9.80 | 15.25735 | 16.09861 | 15,98205 | 15.56247 |
| 7.44 | 5.27608 | 5.55807 | 5,54691 | 5 54600 | 9.84 | 15 76564 | 16.63669 | 16.51431 | 16.07791 |
| 7.52 | 5.48720 | 5.78047 | 5.76744 | 5.65423 | 9.92 | 16.02494 | 16.91123 | 16.78588 | 16.34088 |
| 7.56 | 5.59540 | 5.89446 | 5.88046 | 5.76416 | 9,96 | 16.28772 | 17.18948 | 17,06111 | 16.60738 |
| | | | | | | | | | |
| 7.60 | 5.70539 | 6.01035 | 5.99535 | 5.87589 | 10.00 | 16.55401 | 17.47149 | 17.34005 | 16.87747 |
| 7.64 | 5.81720 | 6.12816 | 6,11214 | 5.98945 | | | | | |
| 7,68 | 5.93085 | 6.24791 | 6.23080 | 6 22217 | | | | | |
| 7.76 | 6.16375 | 6.49334 | 6.47413 | 6.34137 | | | | | |
| | 0.20010 | | | | | | 1 | | |
| 7.80 | 6.28305 | 6.61907 | 6.59874 | 6.46249 | | | | | |
| 7.84 | 6.40429 | 6.74684 | 6.72537 | 6.58557 | | | | | |
| 7.88 | 6,52747 | 6.87669 | 6.85405 | 6 93766 | | | 1 | | |
| 7.92 | 6 77021 | 7.14269 | 7.11763 | 6.96672 | | | | | |
| 1.30 | A*1130T | 1.11009 | ·***** | | | l | | | |
| 8.00 | 6,90901 | 7,27889 | 7,25258 | 7.09784 | | | | | |
| 8.04 | 7.04026 | 7.41727 | 7.38968 | 7.23102 | | | l | | |
| 8.08 | 7.17358 | 7.55785 | 7.52895 | 7.36631 | | | | | |
| 8.12 | 7.30901 | 7.70066 | 7.07042 | 7-64307 | | | | | |
| 8.16 | 1.99007 | 1.04012 | 1.01415 | 1.04021 | il | | | | <u>ا</u> |

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TABLE II - VARIATION OF FWITH MACH NUMBERMANDVELOCITY-PROFILEPARAMETERN

$$\begin{bmatrix} \int_{0.100}^{M} \phi dM_{1} \\ \underline{F} = e \end{bmatrix}$$

(a) Subsonic flow.

| Mach | Velc | city-profile | e parameter | , N |
|-------|--------------------|--------------|-------------|-----------|
| M | 5 | 7 | 9 | 11 |
| 0.100 | 1.00000 | 1.00000 | 1.00000 | 1.00000 |
| .200 | 10.34448 | 9.56047 | 9.15004 | 8.89591 |
| .300 | 39.68497 | 35.04360 | 32.70139 | 31.28207 |
| .400 | 100 .67 640 | 86,12166 | 78.96629 | 74.69695 |
| .500 | 202.51727 | 109.11741 | 153.02743 | 143.53902 |
| .600 | 350.36128 | 287.03727 | 257.03315 | 239.51305 |
| .700 | 544.60092 | 439.26097 | 390.03557 | 361.52642 |
| .800 | 780.98726 | 621.77891 | 548.27530 | 506.01402 |
| .900 | 1060.19229 | 827.91431 | 725.83398 | 667.52563 |
| 1.000 | 1367.58348 | 1049.26411 | 915.43551 | 839.44246 |

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TABLE II - VARIATION OF F WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued



(b) Supersonic flow.

| Number F Y100157-profile parameter, W 1.00 1.00000 1.00000 1.00000 1.00500 1.60507 1.65371 1.65373 1.55361 1.45906 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.46306 1.35703 1.35851 1.3660 1.357400 1.357400 1.357400 1.35740 1.35740 1.327400 1.4596 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 1.35740 | Mach | Weller | A | | | Kanh | | | | |
|---|--------|---------|-----------|-----------|---------|--------|----------|------------------|------------------|---------|
| H 5 7 9 11 8 7 9 11 1.00 1.00000 1.00000 1.00000 1.00000 1.63715 1.53715 1.55001 1.00 1.1090 1.10940 1.10940 1.10940 1.63715 1.55001 1.538451 1.55601 1.12 1.32524 1.33290 1.22543 3.552 1.60026 1.45316 1.46906 1.22 1.45213 1.43007 1.42001 1.41322 3.661 1.46036 1.43036 1.40332 1.41332 1.41332 1.41332 1.41332 1.41342 1.41342 1.41344 1.41342 | number | Veloci | ty-profil | e parame | ter, N | muther | Veloci | ty-profil | e paramet | er, N |
| 1.00 1.00000 1 | X | 5 | 7 | 9 | 111 | M | 5 | 7 | 9 | 1 11 |
| 1.003 1.109013 1.00649 1.00463 1.00853 5.44 1.67363 1.58500 1.55865 1.55014 1.55845 1.55956 1.55344 1.45765 1.54594 1.515745 1.55945 1.57956 1.57956 1.57956 1.57956 1.57954 1.4565 1.53647 1.54596 1.54595 1.57956 1.57956 1.57956 1.57954 1.53545 1.53657 1.54596 1.54595 1.57956 1.57956 1.57954 1.53545 1.53657 1.54596 1.54595 1.57956 1.57956 1.54545 1.57757 1.44458 1.53535 1.53657 1.54596 1.52059 1.52556 1.54545 1.57574 1.44545 1.53535 1.52057 1.52059 1.52556 1.54455 1.53545 1.53555 1.28057 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.22059 1.22556 1.2055 1.12015 1.12059 1.22569 1.22556 1.26051 1.22059 1.22556 1.26051 1.22059 1.22556 1.26051 1.22059 1.22556 1.2055 1.12015 1.12057 1.12059 1.02556 1.06053 1.02051 1.02071 1.20569 1.22556 1.26053 1.2055 1.02051 1.20551 1.02071 1.20569 1.25552 1.26053 2.21525 2.25755 2.25616 4.260 9.0774 0.96755 1.00074 0.96227 0.9567 1.00277 1.02575 1.00276 1.00575 0.00074 0.06227 0.9565 1.00276 0.00774 0.96227 0.9567 1.00277 1.02571 1.02571 1.00271 0.02771 0.02575 1.00074 0.96227 0.9567 1.25697 2.3566 2.35765 2.3566 4.25619 4.446 0.9553 0.30074 0.96227 0.9567 1.25699 2.25552 2.34555 2.34675 4.365 0.00067 0.37745 0.25679 0.37776 0.25579 0.2565 0.100077 0.05750 0.00577 0.0563 0.00077 0.05257 0.00077 0.05257 0.00077 0.05257 0.00077 0.05257 0.00077 0.05257 0.0000 0.75542 0.77655 0.25619 0.25679 0.00670 0.7754 | 1.00 | 1.00000 | 1.00000 | 1.00000 | 1.00000 | 3.40 | 1.70781 | 1.61541 | 1.53715 | 1.58093 |
| 1.009 1.1209 1.2734 1.16946 1.16717 3.46 1.63977 1.55008 1.5487 1.46906 1.12 1.2798 1.26000 1.25307 1.25043 5.52 1.6002 1.51927 1.44972 1.46357 1.46906 1.20 1.45213 1.43097 1.42001 1.41382 3.56 1.57314 1.44972 1.46353 1.46906 1.28 1.65024 1.51377 1.5002 1.64306 3.64 1.50610 1.42041 1.6508 1.43708 1.47942 1.428 1.54024 1.51377 1.5002 1.64306 3.64 1.50610 1.42041 1.6508 1.43708 1.47943 1.428 1.64058 1.59406 1.57013 5.68 1.47708 1.35658 1.34500 1.34204 1.536 1.77010 1.74650 1.67306 3.76 1.44498 1.35658 1.34560 1.34500 1.34204 1.540 1.96674 1.62064 1.79790 1.78481 5.80 1.35842 1.30655 1.2867 1.28971 1.28712 1.44 1.94288 1.88966 1.66419 1.64492 3.84 1.33345 1.28063 1.23354 1.22054 1.2502 1.2350 2.7745 2.04079 1.20804 1.0144 5.80 1.35842 1.30655 1.28354 1.22054 1.2502 2.07315 2.04079 1.20804 1.0144 5.80 1.23665 1.19015 1.23054 1.22054 1.2502 2.07315 2.04079 2.02030 1.25655 1.19015 1.18007 1.18097 1.40 2.20024 2.12613 2.0916 2.07886 4.00 1.23661 1.17776 1.15523 1.12064 1.25080 2.17438 2.13093 2.210703 4.104 1.2119 1.14565 1.00055 1.00205 1.00205 1.792 2.34739 2.25039 2.21073 2.210703 4.104 1.2119 1.14565 1.00357 1.00256 1.00204 2.2288 2.32642 2.22532 2.23546 4.00 1.23661 1.17276 1.15523 1.00055 1.00265 1.00204 2.22802 2.25542 2.25352 2.25352 2.25356 2.25576 1.0077 1.00710 1.05770 1.05580 1.0027 1.0071 1.0055 1.00265 1.00265 1.00265 1.0025 1.00265 1.00265 1.00265 1.00265 1.00265 1.00265 1.00265 1.0027 1.00710 1.05850 1.05850 1.0027 1.00171 1.0057 1.0077 1.0077 1.0077 1.0077 1.0058 1.00277 1.0077 1.00580 1.0027 2.5530 2.24350 2.24350 2.25502 2.25504 4.24 1.00153 1.00377 1.0077 1.0077 1.05880 1.0027 1.0077 1.0077 1.05880 1.0027 1.0077 1.0077 1.05880 1.0027 1.0077 1.0077 1.05880 2.002 2.5530 2.44553 2.34500 2.3566 4.284 1.00153 1.00377 1.0077 1.05880 1.0027 1.0077 1.0077 1.0588 1.00877 2.00867 2.00807 4.20 1.00581 0.00377 1.0077 1.0078 2.00804 2.00807 2.25502 2.00877 2.35064 2.25607 2.3566 2.25607 2.3566 2.25607 2.3566 2.25677 2.3566 2.25677 2.3566 2.25677 2.3566 2.25677 2.3566 2.25677 2.3568 2.2 | 1.04 | 1.09013 | 1.08649 | 1.08463 | 1.08353 | 3.44 | 1.67363 | 1.58304 | 1,55568 | 1.55001 |
| 1.12 1.27129 1.25000 1.25307 1.25043 3.52 1.60020 1.51927 1.43518 1.45906 1.20 1.45213 1.43047 1.43001 1.41382 5.60 1.54041 1.45596 1.43306 1.42943 1.42943 1.45038 1.43047 1.45001 1.41382 5.60 1.54041 1.45596 1.43306 1.42943 1.42943 1.45038 1.43047 1.45001 1.41382 5.60 1.54041 1.45596 1.43241 1.40323 1.42943 1.45038 1.5377 1.55002 1.54956 5.44 1.50510 1.42841 1.40525 1.40016 1.42943 1.54958 1.5377 1.57050 5.76 1.41388 1.53753 1.51061 1.57120 1.55 1.7010 1.67305 1.54956 1.64455 5.72 1.4442 1.35655 1.24897 1.57050 1.7485 1.79101 1.74853 1.72797 1.77850 5.76 1.41388 1.53753 1.51061 1.51475 1.40 1.96874 1.82084 1.79790 1.74841 5.80 1.3824 1.30655 1.24897 1.22992 1.44 1.9428 1.89896 1.96419 1.84992 3.94 1.35145 1.28023 1.22098 1.22992 1.46 2.01346 1.95473 1.92594 1.81143 5.80 1.33277 1.25239 1.22534 1.23512 1.2602 2.07915 2.0159 1.98058 1.48017 3.92 1.28051 1.22502 1.20777 1.2064 1.56 2.14226 2.07315 2.04079 2.02201 5.94 1.25110 1.12520 1.20777 1.15523 1.1602 1.20024 2.12613 2.0516 2.07926 4.00 1.23560 1.172776 1.15523 1.06575 1.10657 1.1601 1.10612 1.10627 1.10617 1.10612 1.72 2.34759 2.25539 2.21332 2.13793 4.12 1.15790 1.03555 1.00855 1.06850 1.662 2.3026 2.217452 2.23541 2.23644 4.00 1.2119 1.14568 1.10677 1.10612 1.00271 2.0505 1.00805 1.00805 1.00805 1.00805 1.602 2.42288 2.32676 2.28341 2.26094 4.20 1.10657 1.00355 1.00805 1.00805 1.602 2.42288 2.32676 2.28341 2.26094 4.20 1.10657 1.00355 1.00805 1.00805 1.602 2.42288 2.32676 2.28341 2.28094 4.28 1.00135 1.00371 1.01677 1.01271 0.0277 2.30358 2.34020 4.35 1.01035 0.30627 .30646 .30576 1.6027 2.37358 2.42356 2.37518 2.35057 4.40 9.4758 9.03466 .9337 .90307 2.60 2.55292 2.41197 2.36435 2.34020 4.35 1.01035 0.30627 .30646 .30576 1.6027 2.3758 2.24227 2.37518 2.35057 4.40 9.47578 .90366 .9337 .90307 2.60 2.55292 2.43056 2.37518 2.35057 4.40 9.47578 .90366 .9337 .90307 2.60 2.55292 2.43056 2.37518 2.35057 4.40 9.4751 .90353 .90562 .94474 .4474 2.60 2.55292 2.43056 2.37518 2.35057 4.400 .97753 .90366 .9337 .90307 2.60 2.55292 2.43056 2.3 | 1.08 | 1.18099 | 1.17334 | 1,16946 | 1.16717 | 3.48 | 1.63977 | 1.55098 | 1.52451 | 1.51938 |
| 1.16 1.56224 1.54594 1.53764 1.3376 1.41362 5.60 1.57014 1.44792 1.46315 1.45064 1.45164 1.45166 1.42015 1.420 | 1,12 | 1.27198 | 1.26000 | 1.25397 | 1.25043 | 3.52 | 1.60626 | 1.51927 | 1.49367 | 1.48905 |
| 1.20 1.45037 1.42001 1.41382 5.60 1.54041 1.42641 1.43306 1.42943 1.32 1.54024 1.31373 1.50042 1.63035 5.64 1.50610 1.42641 1.43201 1.33 1.77100 1.74633 1.77277 1.71650 3.764 1.33642 1.30655 1.28087 | 1.16 | 1.36254 | 1.34594 | 1.33764 | 1.33280 | 3.56 | 1.57314 | 1.48792 | 1.46318 | 1.45906 |
| 1.22 1.6263 1.5907 1.5002 1.7802 5.00 1.7803 1.7809 1.8909 1.9809 1.8909 1.8909 1.8909 1.8909 1.8009 1.800 1.8302 1.5805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2805 1.2809 1.2509 1.9805 1.08017 5.96 1.3505 1.2805 1.2805 1.2809 1.2509 1.9805 1.80017 5.96 1.991 1.28002 1.2800 1.22800 1.22800 1.22800 1.22800 1.22800 1.22809 1.18097 1.1809 | 1 20 | 1 45013 | 3 43067 | 1 40001 | 1 41300 | 7 40 | 5 54043 | 3 45 606 | 1 17700 | 1 10010 |
| 1:32 | 1.20 | 1.40213 | 1.43067 | 1,42001 | 1.41382 | 3.60 | 1.54041 | 1.45696 | 1.43306 | 1.42943 |
| 1.33 1.77010 1.74020 1.754462 3.76 1.44462 1.33626 1.34000 1.54267 1.46 1.86074 1.80064 1.77797 1.77650 3.76 1.41388 1.33753 1.34001 1.24272 1.44 1.94298 1.88064 1.69492 3.64 1.35345 1.22002 1.22008 1.22008 1.22509 1.23507 1.22509 1.23507 1.22509 1.23515 1.18007 1.22069 1.23515 1.18007 1.20081 1.20091 1.22002 1.230717 1.22064 1.23515 1.18007 1.18007 1.18007 1.18007 1.18007 1.18017 | 1 28 | 1 62639 | 1 59/63 | 1 57006 | 1 57013 | 3.04 | 1.00010 | 1 30607 | 1.40332 | 1.40016 |
| 1.36 1.79101 1.76853 1.72797 1.71850 3.76 1.41386 1.33733 1.31667 1.21475 1.44 1.94296 1.89674 1.92694 1.97760 1.74841 3.90 1.35345 1.28057 1.28092 1.44 1.94296 1.98676 1.92694 1.91143 3.98 1.35257 1.25220 1.23344 1.23961 1.22520 1.23341 1.23961 1.55 2.0795 2.01582 2.07185 2.00786 1.9617 1.226645 1.1915 1.18097 1.18097 1.60 2.20240 2.212613 2.00163 2.07284 4.00 1.2119 1.14561 1.12996 1.10017 1.0017 1.62 2.20302 2.13732 2.13078 2.20572 2.20572 2.00746 1.02671 1.00171 1.00570 1.06826 1.64 2.202661 2.28362 2.23522 2.24562 2.3077 2.30814 4.20 1.00171 1.00570 1.00585 1.00271 1.01071 1.00271 1.01271 1.00271 1.01271 1.01271 1.01271 1.01271< | 1.32 | 1.71010 | 1.67302 | 1.65496 | 1.64465 | 3.72 | 1 44482 | 1 36659 | 1 34500 | 1 34201 |
| 1.40 1.86674 1.62064 1.79780 1.78481 3.80 1.53655 1.28052 1.28072 1.44 1.94296 1.89966 1.6419 1.449292 3.84 1.53545 1.22023 1.22092 1.55 2.1242 2.07395 2.01593 1.99536 1.96917 3.92 1.22501 1.22502 1.23071 1.22501 1.55 2.12422 2.07315 2.04072 2.02334 1.9951 1.18097 1.18097 1.66 2.20024 2.12133 2.0166 2.07286 4.00 1.23661 1.17176 1.15553 1.18097 1.76 2.35739 2.25833 2.21832 2.10733 4.161 1.13021 1.00171 1.06553 1.06853 | 1.36 | 1.79101 | 1.74853 | 1.72797 | 1.71630 | 3.76 | 1.41388 | 1.33733 | 1.31661 | 1.31475 |
| 1.46 1.96674 1.8004 1.70760 1.70461 3.60 1.95842 1.30555 1.28057 1.28792 1.46 1.95476 1.96476 1.92694 1.91143 3.68 1.32397 1.25239 1.22502 1.2509 2.01346 1.95476 1.92694 1.91143 3.68 1.32397 1.25239 1.22502 1.2071 1.2506 2.14228 2.07315 2.04079 2.02301 3.96 1.26555 1.19815 1.18097 1.18097 1.60 2.20094 2.212813 2.04079 2.02301 3.96 1.26655 1.19815 1.18097 1.18097 1.60 2.20094 2.212813 2.04078 2.07886 4.00 1.23861 1.17176 1.15523 1.15556 1.72 2.34739 2.25539 2.21845 2.11844 4.04 1.13191 1.14568 1.12996 1.109675 1.062 2.20294 2.21282 2.19095 2.16033 4.00 1.23861 1.17176 1.15523 1.15656 1.64 2.2530 2.17485 2.21839 2.21847 4.10 1.13203 1.07110 1.06370 1.06870 1.602 2.42289 2.23876 2.28361 2.26094 4.20 1.10667 1.04716 1.03362 1.05870 1.602 2.42289 2.32876 2.228361 2.26094 4.20 1.10667 1.00716 1.03362 1.05870 1.602 2.42280 2.32876 2.228361 2.26094 4.20 1.10667 1.00716 1.03362 1.05870 1.602 2.42392 2.35612 2.30961 2.36091 4.28 1.05750 1.00074 .98262 .99049 1.92 2.50297 2.35641 2.30961 2.35994 4.20 1.10657 1.00074 .98262 .99049 2.002 2.53530 2.41197 2.36438 2.34020 4.35 1.00056 .95724 .96627 .96872 2.004 2.54571 2.43155 2.36854 2.35815 4.44 .96518 .91357 .90304 .90534 2.002 2.55130 2.41197 2.36438 2.35615 4.46 .94333 .92924 .98264 .99254 2.004 2.55531 2.43728 2.39740 2.35589 4.456 .90106 .95303 .94378 .94730 2.002 2.55131 2.43044 2.39018 2.35625 4.60 .90106 .95303 .94378 .94730 2.202 2.55131 2.43044 2.39618 2.35626 4.70 2.302.5512 2.4128 2.35374 2.33477 4.246 .90340 .76030 .76344 2.4424 .447133 2.34790 2.39552 2.34057 2.35854 4.60 .90106 .95303 .94378 .94730 2.20 2.55132 2.4128 2.35474 2.33477 4.646 .90565 .91347 .90340 .90607 2.10 2.5542 2.42278 2.37744 2.33477 2.23564 4.70 .92346 .92347 .92582 2.402.49108 2.36775 2.31775 2.23774 4.84 .76739 .77374 .9743 .77058 .7744 .77068 .77441 .77068 .77441 .77068 .77441 .77068 .7744 2.47482 2.34079 2.23547 4.2464 .94444 .94444 .94444 .94444 .94444 2.44713 2.34799 2.23547 4.29494 2.93437 .69340 .76059 .75542 .77048 .70642 .27678 2.210142 2.13598 2.0117 | | | | | | | | | | |
| 1.44 2,01346 1,95478 1,92958 1,96419 1,64992 3,64 1,35345 1,28023 1,25398 1,25398 1,22598 1,22598 1,22598 1,22598 1,22599 1,22509 1,20509 1,00550 1,00550 1,00550 1,00550 1,00550 1,00550 1,00550 1,00560 1,00560 1,00529 1,25509 2,255529 2,43505 2,35652 2,35656 2,35618 4,44 0,96518 0,3557 0,00504 0,99626 0,90649 1,2552 0,22556 2,23655 2,36552 2,36552 2,45509 2,25529 2,45056 2,35626 2,35618 4,44 0,96518 0,3557 0,00504 0,99626 0,9069 1,22559 2,24555 2,23652 2,24505 2,36552 2,36562 2,36562 4,560 0,8055 0,83373 0,3456 0,92547 0,38265 0,86647 0,2052 2,5529 2,43505 2,36552 2,36562 4,560 0,8055 0,83373 0,3458 0,86647 0,2052 2,5529 2,43505 2,36552 2,3652 4,66 0,8055 0,83373 0,3458 0,86647 0,2052 2,5529 2,43505 2,3652 2,3652 4,66 0,8055 0,81437 0,30640 0,3021 2,35542 2,4750 2,35642 2,35622 4,66 0,8055 0,83373 0,3458 0,86647 0,2059 0,2756 2,34575 2,35622 2,43562 2,3656 2,3626 4,7659 0,77643 7,76534 7,7775 2,20506 7,741 7,77066 7,7741 7,77064 7,7754 7,72066 7,741 7,77064 7,7754 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7,7509 7,7549 7 | 1.40 | 1.86874 | 1.82084 | 1.79780 | 1.78481 | 3.80 | 1,38342 | 1.30855 | 1,28857 | 1.28712 |
| 1.46 2.01346 1.95478 1.92544 1.92143 3.86 1.323507 1.225202 1.223501 1.23354 1.55 2.07995 2.01359 1.93551 1.93051 1.22502 1.22502 1.22502 1.22502 1.22502 1.20071 1.22664 1.60 2.20024 2.12613 2.09166 2.07286 4.00 1.23661 1.17176 1.15523 1.16097 1.16097 1.64 2.25350 2.17435 2.15035 2.16033 4.02 1.215790 1.02553 1.00612 1.77 2.34739 2.25920 2.25362 2.25044 4.20 1.06553 1.005561 1.005562 1.005561 1.005562 1.005561 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00571 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00570 1.00571 1.00570 1.00570 1. | 1.44 | 1.94298 | 1,88966 | 1,86419 | 1.84992 | 3.84 | 1.35345 | 1.28023 | 1.26098 | 1,25992 |
| 1.58 2.07995 2.03595 1.93615 1.28601 1.22502 1.20971 1.20097 1.56 2.14226 2.07135 2.04079 2.02301 3.96 1.22665 1.19215 1.10097 1.20097 1.60 2.20024 2.12613 2.09166 2.07286 4.00 1.22661 1.17176 1.15523 1.150617 1.64 2.202024 2.12613 2.19195 2.10234 4.00 1.23661 1.10171 1.01517 1.10617 1.77 2.35739 2.22532 2.25352 2.25144 4.12 1.13203 1.00570 1.068208 1.78 2.35673 2.23676 2.28644 4.24 1.01667 1.01711 1.01771 1.01271 1.88 2.46305 2.3777 2.33172 2.3017 2.36294 4.326 1.00357 .98627 .98647 2.04 2.45571 2.35635 4.424 .00107 .98622 .98047 .98245 .98047 .98245 .98254 .98254 .98254 .98047 .98245 .98254 .98257 .98252 .94567 </th <th>1,48</th> <th>2.01346</th> <th>1.95478</th> <th>1.92694</th> <th>1.91143</th> <th>3.88</th> <th>1.32397</th> <th>1.25239</th> <th>1.23384</th> <th>1.23315</th> | 1,48 | 2.01346 | 1.95478 | 1.92694 | 1.91143 | 3.88 | 1.32397 | 1.25239 | 1.23384 | 1.23315 |
| 1.60 2.007315 2.007315 2.007315 2.007304 2.007286 4.000 1.228651 1.19915 1.180097 1.180097 1.64 2.265380 2.17435 2.13839 2.11844 4.004 1.23861 1.17176 1.15523 1.15525 1.77 2.34739 2.21923 2.19035 2.16033 4.09 1.14248 1.12045 1.10612 1.77 2.34739 2.229302 2.219323 2.19703 4.12 1.15703 1.00553 1.00805 1.00625 1.80 2.42238 2.32676 2.28362 2.23145 4.16 1.13203 1.00171 1.01671 1.84 2.445392 2.35612 2.30944 4.20 1.00667 1.002371 1.01071 1.01271 1.88 2.443058 2.37518 2.34020 4.35 1.001035 .96627 .96637 2.00 2.55240 2.43155 2.36254 2.35615 4.44 .96137 .90637 .90637 .90647 .92652 .94474 .94740 .90257 .90537 .902364 .90267 .92351 | 1,52 | 2.07995 | 2.01599 | 1,98585 | 1.96917 | 3.92 | 1.29501 | 1.22502 | 1.20717 | 1.20684 |
| 1.60 2.20024 2.10513 2.00164 2.007264 4.00 1.23631 1.17170 1.15523 1.15556 1.64 2.25300 2.17435 2.15035 2.11864 4.04 1.21113 1.14566 1.120951 1.10017 1.10017 1.77 2.34739 2.29052 2.2032 2.10734 4.12 1.13203 1.000051 1.008208 1.76 2.38739 2.29052 2.20344 4.12 1.13203 1.001351 1.008208 1.76 2.38739 2.29052 2.25044 4.20 1.006371 1.001351 1.008208 1.84 2.45058 2.37170 2.3010 2.30814 4.28 1.00371 1.01271 1.01271 1.96 2.52120 2.41197 2.35097 4.30 1.00135 1.00371 1.01271 .01271 2.00 2.55240 2.43504 2.35097 4.30 1.01357 .90364 92265 2.00 2.55229 2.35624 2.56194 2.36254 | 1.00 | 2.14226 | 2.07315 | 2.04079 | 2.02301 | 3,96 | 1.26655 | 1.19815 | 1.18097 | 1.18097 |
| 1.64 2.55360 2.17485 2.11853 2.11864 4.04 1.21116 1.12055 1.10017 1.10017 1.66 2.50266 2.21928 2.1995 2.16055 4.06 1.10205 1.10017 1.10017 1.10017 1.10017 1.10017 1.10017 1.100206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00206 1.00207 | 1.60 | 2.20024 | 2.12613 | 2.09164 | 2.07284 | 4.00 | 1,23861 | 1.17176 | 1.15523 | 1 15554 |
| 1.66 2.50266 2.21222 2.15035 2.15035 4.06 1.15422 1.15590 1.06505 1.10612 1.72 2.44739 2.25339 2.21932 2.19793 4.12 1.15790 1.09553 1.06505 1.06505 1.80 2.42238 2.352476 2.25352 2.25314 4.12 1.06677 1.04716 1.03562 1.03538 1.84 2.45392 2.35412 2.30961 2.26464 4.24 1.00137 1.0171 </th <th>1.64</th> <th>2.25380</th> <th>2.17485</th> <th>2.13839</th> <th>2.11884</th> <th>4.04</th> <th>1.21119</th> <th>1.14586</th> <th>1.12996</th> <th>1.13061</th> | 1.64 | 2.25380 | 2.17485 | 2.13839 | 2.11884 | 4.04 | 1.21119 | 1.14586 | 1.12996 | 1.13061 |
| 1.72 2.34739 2.25339 2.21932 2.1972 3.412 1.15730 1.00555 1.0006 1.00580 1.76 2.36739 2.25520 2.25352 2.23145 4.16 1.13203 1.07110 1.05710 1.05580 1.80 2.42288 2.35412 2.30954 2.26094 4.20 1.06671 1.04716 1.03362 1.03588 1.84 2.45392 2.35412 2.30954 2.26094 4.20 1.06671 1.04716 1.03362 1.03586 1.88 2.45058 2.37737 2.33170 2.30954 4.22 1.03367 1.02771 1.01071 1.01271 1.88 2.46058 2.37737 2.33170 2.30954 4.22 1.03367 1.02771 9.8627 9.9627 9.9627 2.30661 2.34990 2.32599 4.32 1.03367 9.97824 9.9627 9.96372 1.96 2.52120 2.41197 2.36435 2.34020 4.36 1.01035 .95622 9.94474 .94740 2.00 2.55540 2.42356 2.37518 2.35087 4.40 .967513 9.93547 9.9628 9.9627 2.04 2.55531 2.43155 2.36254 2.35015 4.44 .94513 8.9224 8.9228 9.9627 2.05 2.55531 2.43562 2.33740 2.35509 4.52 9.9136 8.92284 8.96056 2.12 2.55531 2.43562 2.33740 2.35509 4.52 9.9136 8.92284 8.96056 2.12 2.55531 2.43504 2.35618 2.35625 4.60 8.90635 8.3373 8.9248 8.82855 2.20 2.55131 2.43504 2.36918 2.35625 4.60 8.90655 8.3373 8.9248 8.82855 2.22 2.55432 2.41238 2.36217 4.54 8.90453 8.91497 9.9643 8.01021 2.32 2.52290 2.3955 2.43675 2.33865 4.70 8.90056 8.3373 7.9248 7.70257 2.40 2.40198 2.36715 2.31775 2.25656 4.76 8.90453 7.7041 7.7056 7.77473 2.32 2.02395 2.34947 2.32574 4.88 7.8001 7.7037 7.7036 7.7474 2.40 2.47103 2.3470 2.23824 2.27737 4.84 7.87501 7.7039 7.7056 7.7441 2.766 2.77643 7.7244 2.40289 2.27980 2.23257 2.1833 5.00 7.7037 7.7036 7.7444 2.402 4.47133 2.34707 2.23824 2.27737 4.84 7.87501 7.7039 7.7056 7.7444 2.40 2.47103 2.34707 2.23824 2.27737 4.84 7.87501 7.7039 7.7056 7.7444 2.40 2.47103 2.24722 2.18140 2.16280 5.04 6.99465 6.1941 6.99457 6.5784 2.40289 2.27980 2.23257 2.1833 5.00 7.0027 6.5734 2.40289 2.27980 2.23557 2.1803 5.00 7.7024 7.75357 7.7036 7.7544 2.40289 2.27980 2.23557 2.1803 5.00 7.7027 5.7534 2.40289 2.27980 2.23557 2.18035 5.50 7.7079 5.56431 6.6434 6.64344 6.4344 6.4344 6.4344 6.4344 6.4786 6.24846 6.24344 6.54347 6.57385 6.2077 6.5734 6.57849 2.40289 2.29984 2.20568 5.16 5.015 5.5826 6.57447 5.57971 6.6134 | 1.68 | 2.30286 | 2.21928 | 2.19095 | 2.16033 | 4.08 | 1.18428 | 1.12045 | 1.10517 | 1.10612 |
| 1.76 2.38739 2.29520 2.25352 2.23145 4.16 1.13203 1.07110 1.08700 1.065850 1.80 2.42288 2.32576 2.233170 2.30914 4.200 1.06667 1.00711 1.03762 1.01711 1.86 2.44508 2.37737 2.33170 2.30814 4.28 1.05750 1.00714 98826 .99049 1.92 2.50297 2.36643 2.34900 4.32 1.03367 .97824 .98627 .99049 1.92 2.52202 2.41197 2.36435 2.34020 4.32 1.03367 .97824 .98627 .99049 2.00 2.53540 2.43155 2.35085 4.44 .98518 .91357 .90304 .90607 2.02 2.55131 2.43728 2.35816 4.44 .94518 .91357 .90304 .90607 2.16 2.55492 2.43728 2.35816 4.444 .94518 .91377 .924858 .98606 2.12 2.55512 2.43728 2.35740 2.35874 .464 .980518 .93466 .9 | 1.72 | 2.34739 | 2.25939 | 2.21932 | 2.19793 | 4.12 | 1.15790 | 1.09553 | 1.08085 | 1.08208 |
| 1.80 2.42288 2.32676 2.26361 2.26094 4.20 1.10667 1.04716 1.03362 1.03371 1.0177 <th>1.76</th> <th>2.38739</th> <th>2,29520</th> <th>2,25352</th> <th>2.23145</th> <th>4.16</th> <th>1.13203</th> <th>1.07110</th> <th>1,05700</th> <th>1.05850</th> | 1.76 | 2.38739 | 2,29520 | 2,25352 | 2.23145 | 4.16 | 1.13203 | 1.07110 | 1,05700 | 1.05850 |
| 1.80 2.42288 2.32676 2.26361 2.26094 4.20 1.10667 1.04716 1.03532 1.03532 1.84 2.45039 2.55412 2.30994 2.26646 4.24 1.03133 1.0071 1.01071 1.01071 1.86 2.46058 2.37737 2.33170 2.30811 4.28 1.05750 1.00074 .98626 .90649 1.96 2.550297 2.35661 2.34990 2.35299 4.36 1.01035 .95622 .94474 .94740 2.00 2.553540 2.42355 2.35087 4.40 .98752 .93466 .92367 .92652 2.04 2.55521 2.433055 2.38254 2.58218 4.44 .94333 .89294 .98265 .88606 2.16 2.55543 2.43054 2.38252 2.35016 4.56 .90106 .85337 .9488 .84730 2.20 2.55131 2.43753 2.38251 2.4887 .66905 .81497 .90640 .81021 2.22 2.55131 2.43042 2.38042 2.38247 2.38862 | | | | | | | | | | |
| 1.68 2.40582 2.50954 2.20846 4.24 1.03183 1.02371 1.01071 1.01271 1.88 2.40568 2.37737 2.35170 2.30811 4.28 1.03567 .97824 .98267 .96672 1.96 2.55297 2.33661 2.35087 4.30 1.01035 .95622 .94474 .94740 2.00 2.55540 2.42356 2.3718 2.35087 4.40 .99752 .93466 .92367 .92652 2.04 2.55531 2.43066 2.36856 2.35218 4.44 .94333 .99294 .92367 .90267 2.08 2.55531 2.43762 2.35714 2.35208 4.48 .94333 .99294 .92367 .94268 .98667 2.12 2.55531 2.43762 2.35822 2.36106 4.52 .92196 .87776 .86330 .94377 .94473 2.20 2.55131 2.43742 2.30218 2.36223 4.60 .98063 .83373 .82488 .82855 2.220 2.555312 2.41273 2.37244 2.34677 </th <th>1.80</th> <th>2.42288</th> <th>2.32676</th> <th>2.28361</th> <th>2.26094</th> <th>4.20</th> <th>1.10667</th> <th>1.04716</th> <th>1.03362</th> <th>1.03538</th> | 1.80 | 2.42288 | 2.32676 | 2.28361 | 2.26094 | 4.20 | 1.10667 | 1.04716 | 1.03362 | 1.03538 |
| 1.68 2.48058 2.57737 2.53761 2.30490 2.30259 4.28 1.05750 1.00074 .98826 .99049 1.96 2.55210 2.41197 2.54352 2.34920 4.36 1.01035 .95622 .94474 .94740 2.00 2.554571 2.43155 2.37518 2.55815 4.40 .98752 .93466 .92267 .92262 2.04 2.54571 2.43155 2.38654 2.35815 4.44 .94333 .89294 .99285 .98606 2.12 2.55531 2.43532 2.36509 4.52 .92136 .87276 .86510 .986647 2.12 2.55513 2.43532 2.36217 2.35862 4.60 .80065 .81377 .92488 .82855 2.28 2.55212 2.41238 2.34627 2.33862 4.60 .80065 .81377 .90440 .81021 2.28 2.55212 2.41238 2.36217 2.31777 4.64 .86065 .81497 .90643 .77941 .77068 .77747 2.36 2.52202 .77941 .77066 </th <th>1.84</th> <th>2.45392</th> <th>2.35412</th> <th>2.30964</th> <th>2.28646</th> <th>4.24</th> <th>1.08183</th> <th>1.02371</th> <th>1.01071</th> <th>1.01271</th> | 1.84 | 2.45392 | 2.35412 | 2.30964 | 2.28646 | 4.24 | 1.08183 | 1.02371 | 1.01071 | 1.01271 |
| 1.96 2.50257 2.50435 2.52697 4.36 1.05367 .97824 .96627 .96637 2.00 2.55540 2.43155 2.36435 2.35815 4.40 .99752 .93466 .92257 .92677 .92677 .92677 .92677 .92677 .92677 .92677 .92677 .92674 .92677 .92677 | 1.88 | 2.48058 | 2.37737 | 2.33170 | 2.30811 | 4.28 | 1.05750 | 1,00074 | .98826 | .99049 |
| 1.90 2.55120 2.41197 2.564020 4.36 1.01055 .95522 .94474 2.00 2.53540 2.42356 2.37518 2.35087 4.40 .98752 .93466 .902367 .92652 2.04 2.54571 2.43155 2.38254 2.55219 .44306 .93267 .96518 .91357 .902367 .92652 2.04 2.55531 2.43728 2.38740 2.55309 4.44 .94333 .89245 .88606 2.12 2.55531 2.43728 2.38740 2.56106 4.55 .90106 .85303 .94378 .844730 2.20 2.55131 2.43044 2.38612 2.38822 4.66 .84113 .79443 .78244 .77241 .77068 .77441 .77068 .77441 .77068 .77441 .77068 .77441 .77068 .77441 .77068 .77441 .77057 .72006 .72441 .466 .64113 .74360 .73542 .77441 .77058 .77441 .77058 .772079 .72079 .72079 .72069 .72079 .72069 . | 1.92 | 2.50297 | 2.39661 | 2.34990 | 2.32599 | 4.32 | 1.03367 | .97824 | .96627 | .96872 |
| 2.00 2.53540 2.42356 2.37518 2.35087 4.40 .98752 .93466 .92367 .92652 2.04 2.54571 2.43366 2.38652 2.35613 4.44 .96518 .91357 .90304 .90607 2.16 2.55229 2.43666 2.38652 2.36218 4.48 .94333 .89294 .88285 .88606 2.16 2.55531 2.43728 2.38522 2.36106 4.56 .90106 .853373 .8438 .88285 2.20 2.55531 2.43044 2.36217 2.34877 4.64 .86065 .91497 .90640 .90121 2.32 2.5512 2.41238 2.36217 2.38824 .668 .84113 .79643 .78634 .79227 2.32 2.52290 2.39952 2.34953 2.34952 .21473 .464 .76739 .73679 .7206 .72441 2.44 2.47133 2.34790 2.26734 4.86 .75079 .7206 .72441 2.44 2.47132 2.37790 2.26734 4.86 .75039 <t< th=""><th>7.30</th><th>2.52120</th><th>2.41197</th><th>2-20433</th><th>2.34020</th><th>4.00</th><th>1.01032</th><th>.93622</th><th>.94474</th><th>.94740</th></t<> | 7.30 | 2.52120 | 2.41197 | 2-20433 | 2.34020 | 4.00 | 1.01032 | .93622 | .94474 | .94740 |
| 2:04 2:5457 2:43565 2:38656 2:35615 4:44 :96518 :91357 :90304 :90807 2:08 2:55229 2:43606 2:38656 2:3619 4:48 :94333 :99294 :92296 :92276 :86510 :86647 2:12 2:55531 2:43728 2:39740 2:35623 4:60 :90106 :85303 :94378 :84730 2:24 2:55131 2:43044 2:39181 2:34877 :464 :86065 :31373 :82488 :82855 2:24 2:54465 2:37244 2:34877 :464 :60051 :77941 :77064 :777473 2:36 2:50316 2:35472 :2:3542 :2:35474 :4.92 :76030 :73542 :77577 2:40 2:49108 2:36715 2:31775 :2:29568 4.90 :78519 :74360 :73654 :74080 2:44 2:47183 2:347970 :2:29574 4.92 :73504 :59433 :68211 :69273 2:52 :2:42748 :2:30407 :2:25734 4.92 :73504 | 2.00 | 2.53540 | 2.42356 | 2.37518 | 2.35087 | 4.40 | .98752 | .93466 | 92367 | .92652 |
| 2.08 2.5529 2.43266 2.38566 2.36218 4.48 .94333 .69294 .86210 .86210 2.12 2.55531 2.43728 2.39740 2.56309 4.55 .92196 .87276 .86310 .86647 2.16 2.55492 2.43535 2.38522 2.36106 4.56 .92196 .87276 .86310 .86477 2.20 2.55131 2.43044 2.38018 2.35623 4.60 .88063 .83373 .92488 .82855 2.28 2.55121 2.41238 2.36217 2.33862 4.66 .64113 .79643 .79634 .79634 .79634 .79634 .79634 .79634 .77673 .73657 .232757 .233862 .234737 .23542 .234737 .2476 .80340 .76080 .75342 .75757 .77744 .70206 .72441 .74680 .74569 .74680 .74569 .72066 .72441 .24748 .230407 .25734 .4.88 .75001 .71037 .70395 .70206 .72441 .64786 .67283 .67743 .66247 . | 2.04 | 2,54571 | 2.43155 | 2.38254 | 2.35815 | 4.44 | .96518 | .91357 | .90304 | 90607 |
| 2.12 2.55531 2.43728 2.38740 2.36106 4.52 .92196 .87276 .66310 .68647 2.20 2.55131 2.43535 2.38522 2.36106 4.56 .90106 .85303 .94378 .844730 2.20 2.55131 2.43044 2.38018 2.35623 4.60 .86065 .81437 .90460 .81021 2.28 2.55212 2.41238 2.36217 2.38824 4.66 .64113 .79643 .79643 .79227 2.32 2.52901 2.39555 2.34953 2.32856 4.72 .80340 .76080 .77341 .77068 .77473 2.40 2.49108 2.36715 2.31775 2.29568 4.80 .78519 .74360 .73654 .74080 2.44 2.447133 2.34970 2.29568 4.80 .78519 .74360 .73654 .74080 2.44 2.447043 2.36737 2.285744 4.92 .73304 .59433 .68821 .69273 2.55 2.42748 2.30407 2.25552 .21270 4.96 | 2.08 | 2.55229 | 2.43606 | 2,38656 | 2.36218 | 4.48 | .94333 | .89294 | .88285 | .88606 |
| 2.16 2.55492 2.43535 2.38522 2.36106 4.56 .90106 .85303 .94378 .84730 2.20 2.55131 2.43044 2.38018 2.35623 4.60 .98063 .83373 .82488 .82855 2.28 2.55512 2.41238 2.36217 2.35862 4.66 .98063 .83373 .82488 .82855 2.32 2.55212 2.41238 2.36217 2.33862 4.66 .84113 .79643 .79834 .79834 .79834 .79834 .79227 2.36 2.55212 2.41238 2.34557 2.34557 2.34557 2.34577 .73643 .76739 .77249 .72006 .72441 2.44 2.447133 2.36715 2.21774 4.96 .73054 .572797 .70853 .69273 .69337 .68821 .69273 2.55 2.42748 2.50407 2.25613 2.20757 2.18833 5.00 .70027 .65337 .65781 .66247 2.60 2.37638 2.22772 2.18135 5.00 .664902 .63357 .61614 | 2.12 | 2.55531 | 2.43728 | 2.38740 | 2.36309 | 4.52 | .92196 | .87276 | .86310 | .86647 |
| 2.20 2.55131 2.43044 2.38018 2.35623 4.60 .88063 .83373 .82488 .82855 2.24 2.54465 2.42273 2.37244 2.34877 4.64 .80665 .81497 .90640 .81021 2.32 2.52290 2.39955 2.34953 2.35822 4.68 .8113 .79643 .78534 .79217 2.32 2.52290 2.39955 2.34953 2.32862 4.67 .80340 .76080 .75342 .77577 2.40 2.49108 2.36715 2.31775 2.29568 4.90 .78519 .74360 .73654 .74080 2.44 2.47183 2.34790 2.295737 2.25734 4.98 .75001 .71037 .70395 .70395 .70395 .70395 .62273 2.55 2.40269 2.27937 2.18433 5.00 .70027 .66337 .65781 .66273 2.60 2.37638 2.225413 2.20757 2.18833 5.00 .70027 .66337 .65781 .66243 .64344 .64344 .64344 .64344 | 2,16 | 2.55492 | 2.43535 | 2.38522 | 2.36106 | 4.56 | .90106 | . 85303 | .94378 | .84730 |
| 2.20 2.3013 2.3014 2.3015 2.3023 4.00 .8003 .83375 .32428 .82855 2.24 2.55112 2.42273 2.33042 2.3862 4.66 .64113 .79643 .79834 .79227 2.32 2.52290 2.39955 2.34955 2.32656 4.72 .82005 .77841 .77663 .77473 2.40 2.49108 2.36715 2.31775 2.29568 4.00 .78519 .74360 .73554 .74080 2.44 2.47183 2.36715 2.31775 2.29737 4.84 .76739 .72006 .72441 2.48 2.45057 2.32682 2.27737 4.84 .76739 .7037 .70395 .70275 .65375 | 0.00 | 0 55373 | 0 47044 | 0 70010 | 0.75007 | | 00067 | 07707 | 00400 | |
| 2.28 2.55512 2.41238 2.56217 2.33892 4.68 .84113 .79643 .78634 .79227 2.32 2.52290 2.39955 2.34953 2.32856 4.72 .82205 .777841 .77668 .77473 2.40 2.49108 2.36715 2.31775 2.29568 4.90 .78519 .74360 .73542 .7557 2.44 2.47183 2.36472 2.29737 4.64 .76739 .72606 .72441 2.48 2.45057 2.23682 2.27937 4.64 .71037 .70355 .70839 2.56 2.40269 2.27937 2.18333 5.00 .70027 .66337 .65781 .66247 2.64 2.34868 2.22722 2.18140 2.16280 5.04 .68446 .64844 .64314 .64786 2.72 2.29688 2.17016 2.15283 2.00665 5.12 .65786 .61961 .61481 .61964 2.76 2.28968 2.17016 2.15283 2.00665 5.12 .65737 .65781 .66247 <td< th=""><th>2 24</th><th>2 54465</th><th>2.40044</th><th>2 37044</th><th>2.30023</th><th>4.60</th><th>.06065</th><th>• 63373 91497</th><th>00640</th><th>.82855</th></td<> | 2 24 | 2 54465 | 2.40044 | 2 37044 | 2.30023 | 4.60 | .06065 | • 63373 91497 | 00640 | .82855 |
| 2.32 2.52290 2.33955 2.34957 2.32656 4.72 .82205 .77941 .77068 .77473 2.36 2.50216 2.38442 2.33457 2.31212 4.76 .80340 .76020 .75342 .75757 2.40 2.49108 2.36715 2.29568 4.80 .78519 .74360 .73654 .74080 2.44 2.47133 2.34790 2.29568 4.80 .76739 .72679 .72066 .7241 2.48 2.45057 2.25619 2.23574 4.88 .75001 .71037 .70395 .70839 2.52 2.42748 2.30407 2.25619 2.23574 4.92 .73304 .69433 .68241 .69273 2.56 2.40269 2.27980 2.23255 2.21270 4.96 .71646 .67867 .67283 .67743 2.64 2.34686 2.2272 2.18140 2.16280 5.04 .68446 .644314 .644766 2.76 2.28683 2.14025 2.0640 .5084 .63395 .61061 .61661 .61661 < | 2.28 | 2.53512 | 2.41238 | 2.36217 | 2 33882 | 4.68 | .84113 | 79643 | 78834 | .81021 |
| 2.36 2.50816 2.38442 2.33437 2.31212 4.76 .80340 .76080 .775342 .75757 2.40 2.49108 2.36715 2.31775 2.29568 4.90 .78519 .74360 .73654 .74080 2.44 2.47183 2.34790 2.29394 2.27737 4.84 .76739 .72079 .70395 .70339 .7206 .225619 2.2572 .21910 2.25757 2.18833 5.00 .70027 .66337 .65781 .66247 .65781 .66247 .65385 .62891 .65358 .62891 .63358 .62891 .63358 .62891 .65358 | 2.32 | 2.52290 | 2.39955 | 2.34953 | 2.32656 | 4.72 | 82205 | 77841 | .77068 | 77473 |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | 2.36 | 2,50816 | 2.38442 | 2.33467 | 2.31212 | 4.76 | 80340 | 76080 | .75342 | 75757 |
| 2.40 2.49108 2.36715 2.231775 2.29568 4.80 .76519 .74560 .73654 .74080 2.44 2.47183 2.34790 2.29737 4.84 .76739 .72079 .72006 .72441 2.48 2.45057 2.32682 2.27337 2.25734 4.86 .75001 .71037 .70395 .70239 2.52 2.42748 2.30407 2.25619 2.23574 4.92 .73304 .59433 .68821 .69273 2.56 2.40269 2.27980 2.23255 2.21270 4.96 .71646 .67867 .67283 .67743 2.64 2.37638 2.25413 2.20757 2.18833 5.00 .70027 .66337 .65781 .66247 2.64 2.31973 2.19919 2.15415 2.13620 5.08 .66902 .63385 .62881 .63281 2.72 2.28683 2.17016 2.12593 2.10865 5.12 .65395 .61961 .61481 .61964 2.76 2.26672 2.10957 2.06708 2.08117 5.20 | | | | | | | | | | |
| 2.44 2.47185 2.29394 2.27737 4.86 .76739 .72679 .72076 .72441 2.48 2.45057 2.2862 2.2737 2.86 .70037 .70395 .69273 .59433 .69273 .69274 .69274 .69274 .6247 .6247 .62486 .227722 .18833 5.00 .70027 .66337 .65781 .66247 2.64 2.34668 2.22722 2.18140 2.16280 5.04 .63446 .64444 .64314 .64786 2.72 2.28968 2.17016 2.15293 2.10865 5.12 .65395 .61961 .61481 .61964 2.76 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 .59791 .66601 .60571 .60115 <th>2.40</th> <th>2.49108</th> <th>2.36715</th> <th>2.31775</th> <th>2.29568</th> <th>4,80</th> <th>.78519</th> <th>.74360</th> <th>.73654</th> <th>•74080</th> | 2.40 | 2.49108 | 2.36715 | 2.31775 | 2.29568 | 4,80 | .78519 | .74360 | .73654 | •74080 |
| 2.48 2.48057 2.28087 2.28737 2.28734 4.88 .75001 .71037 .70395 .70839 2.52 2.42748 2.3047 2.25619 2.25574 4.92 .73304 .59433 .68821 .69273 2.56 2.40269 2.27980 2.23255 2.21270 4.96 .71646 .67867 .6783 .69273 2.60 2.37638 2.25413 2.20757 2.18833 5.00 .70027 .66337 .65781 .66247 2.64 2.34868 2.22722 2.19140 2.16280 5.04 .68446 .64844 .64314 .64786 2.72 2.28968 2.1917 2.16280 5.04 .68446 .64844 .64314 .64786 2.72 2.28963 2.14025 2.09688 2.08028 5.16 .63385 .62821 .61961 .61481 .61964 2.76 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.07823 2.06668 1.99113 | 2.44 | 2.47183 | 2.34790 | 2,29894 | 2.27737 | 4.80 | .76739 | .72679 | .72006 | .72441 |
| 2.36 2.42740 2.20407 2.2019 2.2014 4.96 .71646 .67867 .67283 .67743 2.56 2.40269 2.27980 2.23255 2.21270 4.96 .71646 .67867 .67283 .67743 2.60 2.37638 2.25413 2.20757 2.18833 5.00 .70027 .66337 .65781 .66247 2.64 2.34868 2.22722 2.10140 2.15280 5.04 .68446 .64844 .64314 .64786 2.68 2.31973 2.19919 2.15415 2.13820 5.08 .66902 .63385 .62881 .63358 2.77 2.28968 2.17016 2.12593 2.10866 5.12 .65395 .61961 .61481 .61964 2.76 2.228672 2.10957 2.06708 2.05117 5.20 .62438 .59213 .58780 .59271 2.84 2.19407 2.04632 2.00566 1.99113 5.28 .59718 .56595 .56204 .56701 2.92 2.12693 2.01394 1.97423 1.92926 | 2.48 | 2.45057 | 2.32682 | 2.27837 | 2.25734 | 4.88 | .75001 | •71037 | .70395 | .70839 |
| 2.300 2.40205 2.47300 2.42205 2.41270 4.30 .71046 .67667 .67667 .67657 2.60 2.37638 2.22722 2.18130 2.16280 5.04 .68446 .64344 .64314 .64786 2.64 2.34868 2.22722 2.16140 2.16280 5.04 .68446 .64344 .64786 2.64 2.31973 2.1919 2.15415 2.15802 5.08 .66902 .63355 .62881 .63585 2.72 2.28968 2.17016 2.12593 2.10866 5.12 .65395 .61961 .61481 .61964 2.76 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.80 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.07823 2.00566 1.99113 5.28 .55322 .55404 .56701 2.92 2.12693 2.01394 1.97423 1.96038 .52 .55382 | 2.02 | 2.42748 | 2.30407 | 5.55018 | 2.20074 | 4.92 | .75504 | •59433 anoan | .08821 | .69273 |
| 2.60 2.37638 2.25413 2.20757 2.18833 5.00 .70027 .65337 .65781 .66247 2.64 2.34868 2.22722 2.16140 2.16280 5.04 .68446 .64344 .64345 2.68 2.31973 2.19919 2.15415 2.15280 5.08 .66902 .63385 .62881 .63588 2.72 2.28968 2.17016 2.12593 2.10865 5.12 .65395 .61961 .61481 .60601 2.76 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.07823 2.03664 2.02142 5.24 .61086 .57888 .57477 .57971 2.98 2.12693 2.01954 1.97421 .96038 5.32 .55322 .5532 .54962 .55461 2.96 2.02509 1.9413 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.00 2.05800 1.94813 1.91032 1.89785 5.40 | 00.00 | P020503 | 2.2/900 | £ • 60200 | C.C1210 | 4.40 | . / 1040 | .07507 | .01200 | .07743 |
| 2.64 2.34866 2.22722 2.19140 2.16280 5.04 .69446 .64444 .64314 .64786 2.68 2.31973 2.19919 2.15415 2.15620 5.08 .66902 .63385 .62881 .63385 2.72 2.28968 2.17016 2.12593 2.10866 5.12 .65395 .61961 .61481 .60571 2.76 2.25863 2.14025 2.09688 2.08028 5.16 .63924 .60571 .60115 .60601 2.80 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.16077 2.04632 2.00566 1.99113 5.24 .61086 .57883 .57477 .57971 2.88 2.16077 2.04632 2.00566 1.9913 5.24 .61086 .57883 .54922 .55461 .56595 .56204 .557471 .57971 2.92 2.02540 1.98119 1.94242 1.92926 5.36 .57079 .54099 .53746 .54250 .5461 .54250 | 2.60 | 2.37638 | 2.25413 | 2.20757 | 2.18833 | 5.00 | .70027 | .66337 | .65781 | .66247 |
| 2.68 2.31973 2.19919 2.15415 2.13620 5.08 .66302 .63385 .62361 .63385 2.72 2.28968 2.17016 2.12593 2.10866 5.12 .65395 .61961 .61481 .61964 2.76 2.25863 2.14025 2.09688 2.08028 5.16 .63395 .60971 .60115 .60011 2.80 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.04632 2.00566 1.99113 5.28 .61086 .57888 .57477 .57971 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .58382 .55352 .54092 .55461 2.92 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52544 .54564 .51722 .51407 .50278 .50784 .54250 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .51722 .51407 .51912 .50778 .50278 | 2.64 | 2.34868 | 2,22722 | 2.18140 | 2.16280 | 5.04 | .68446 | .64844 | .64314 | .64786 |
| 2.72 2.28968 2.17016 2.12593 2.10866 5.12 .65395 .61961 .61481 .61964 2.76 2.25863 2.14025 2.09688 2.08028 5.16 .63924 .60571 .60115 .60601 2.80 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.07823 2.03664 2.02142 5.24 .61086 .57888 .57477 .57971 2.88 2.16077 2.04632 2.00566 1.99113 5.28 .59718 .56595 .56204 .56701 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .58382 .55352 .54962 .55461 2.92 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .5076 .50278 .50784 3.12 1.95276 1.84789 | 2,68 | 2.31973 | 2,19919 | 2.15415 | 2.13620 | 5.08 | .66902 | .63385 | .62881 | .63358 |
| 2.76 2.25863 2.14025 2.09688 2.08028 5.16 .63924 .60571 .60115 .60601 2.80 2.22672 2.10957 2.06708 2.05117 5.20 .62488 .59213 .58780 .59271 2.84 2.19407 2.07823 2.03664 2.02142 5.24 .61086 .57888 .57477 .57971 2.98 2.16097 2.04632 2.00566 1.99113 5.28 .59718 .55595 .56204 .55701 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .55352 .554962 .55461 2.96 2.09264 1.998119 1.94242 1.92926 5.36 .57079 .54099 .55463 .54250 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.91485 1.89780 1.86621 5.44 .548 .53522 .50576 .50278 .50784 3.12 1.95276 1.84789 1.81300 1.80252 | 2.72 | 2.28968 | 2.17016 | 2.12593 | 2.10866 | 5.12 | .65395 | .61961 | .61481 | .61964 |
| $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | 2.76 | 2.25863 | 2.14025 | 2.09688 | 2.08028 | 5.16 | .63924 | .60571 | .60115 | .60601 |
| 2.84 2.1937 2.0076 2.0077 2.04632 2.00566 1.99113 5.28 .59718 .56595 .56204 .56701 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .58382 .55332 .54962 .55461 2.92 2.025800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .50675 .50278 .50784 .54250 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .50675 .50278 .50784 .54250 3.01 1.98786 1.89780 1.8041 5.4841 5.48 .53552 .50276 .50278 .50784 .50784 .50784 .50784 .5078 | 0 00 | 0 00000 | 0 10057 | 0 06700 | 0.05117 | E 00 | 60400 | 60017 | 50700 | 500T |
| 2.88 2.16077 2.04632 2.00304 2.02142 5.28 5.50718 .56595 .56204 .56701 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .58382 .55332 .54962 .55461 2.92 2.12693 2.01394 1.97423 1.96038 5.32 .58382 .55332 .54962 .55461 2.96 2.09264 1.98119 1.94242 1.92926 5.36 .57079 .54099 .53748 .54250 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.91485 1.87901 1.86621 5.44 .54564 .51722 .51407 .51912 3.08 1.98798 1.86141 1.04555 1.8341 5.48 .535276 .50278 .60794 3.12 1.95276 1.84799 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.78042 1.77059 5.56 | 2.00 | 2 10407 | 2.10937 | 2 03664 | 2.00117 | 5 04 | 61094 | 57000 | • 58780 57470 | .59271 |
| 2.92 2.12693 2.01302 1.97423 1.96038 5.32 .55322 .55461 2.96 2.09264 1.98119 1.94242 1.92926 5.36 .57079 .54962 .55462 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.91485 1.97301 1.86621 5.44 .54564 .51722 .51407 .51912 3.08 1.98798 1.86141 1.64555 1.85441 5.48 .53552 .50576 .50276 .50764 3.12 1.95276 1.84789 1.81300 1.80252 5.55 .51015 .48566 .48100 .48668 3.12 1.95276 1.84789 1.81300 1.80252 5.56 .51015 .48566 .48100 .48608 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .49789 .46024 | 2.89 | 2.16077 | 2.04632 | 2.00566 | 1 00113 | 5.28 | .59719 | .56505 | 56204 | .57971 |
| 2.36 2.09264 1.94212 1.92926 5.36 5.57079 5.54999 5.53748 5.54250 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53748 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.9485 1.67301 1.86621 5.44 .54564 .51722 .51407 .51912 3.06 1.98798 1.86141 1.64555 1.83441 5.48 .53352 .50576 .50278 .50784 3.12 1.95276 1.84789 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.12 1.95276 1.8479 1.8130 1.77069 5.56 .51015 .48366 .49106 .49680 3.20 1.88220 1.76083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 </th <th>2.92</th> <th>2.12693</th> <th>2.01394</th> <th>1.97423</th> <th>1.96038</th> <th>5.32</th> <th>58382</th> <th>.55332</th> <th>.54962</th> <th>.55461</th> | 2.92 | 2.12693 | 2.01394 | 1.97423 | 1.96038 | 5.32 | 58382 | .55332 | .54962 | .55461 |
| 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.91485 1.87301 1.86621 5.44 .54564 .51722 .51407 .51912 3.06 1.98789 1.88141 1.04555 1.68441 5.48 .53352 .50576 .50278 .50784 3.12 1.95276 1.94789 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.79042 1.77069 5.56 .51015 .48366 .48100 .48606 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .48789 .46260 .46024 .4529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.66097 1.65087 1.64350 | 2.96 | 2.09264 | 1.98119 | 1.94242 | 1.92926 | 5.36 | 57079 | .54099 | .53748 | .54250 |
| 3.00 2.05800 1.94813 1.91032 1.89785 5.40 .55806 .52896 .52564 .53067 3.04 2.02309 1.91485 1.87301 1.86621 5.44 .54564 .51722 .51407 .51912 3.08 1.98798 1.86141 1.84555 1.83441 5.48 .53352 .50576 .50278 .50764 3.12 1.95276 1.84739 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.79042 1.77059 5.56 .51015 .48366 .48100 .48606 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .49789 .46260 .46024 .4529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 | 1 | | | | | | | | | |
| 3.04 2.02309 1.91485 1.87301 1.86621 5.44 .54564 .51722 .51407 .51912 3.08 1.98798 1.86141 1.84555 1.83441 5.48 .53352 .50576 .50278 .60784 3.12 1.95276 1.84799 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.78042 1.77069 5.56 .51015 .48366 .48100 .48606 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.88220 1.74739 1.71540 1.70683 5.64 .49789 .46260 .46024 .46529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61389 1.61210 | 3.00 | 2.05800 | 1.94813 | 1.91032 | 1.89785 | 5.40 | .55806 | .52896 | •52564 | .53067 |
| 3.08 1.98798 1.88141 1.84555 1.83441 5.48 5.5352 .50576 .50278 .50784 3.12 1.95276 1.84789 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.78042 1.77059 5.56 .51015 .48366 .48100 .48686 3.20 1.88220 1.78083 1.74767 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.8469 1.74739 1.71540 1.70683 5.64 .48789 .46220 .46024 .4529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61889 1.61289 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.04 | 2.02309 | 1,91485 | 1.87801 | 1.86621 | 5.44 | .54564 | .51722 | .51407 | .51912 |
| 3.12 1.95276 1.84789 1.81300 1.80252 5.52 .52170 .49457 .49176 .49682 3.16 1.91748 1.81434 1.78042 1.77059 5.56 .51015 .48366 .48100 .48606 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .48789 .46260 .46024 .46529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.08 | 1.98798 | 1.68141 | 1.84555 | 1.83441 | 5.48 | .53352 | .50576 | .50278 | .50784 |
| 3.16 1.91748 1.81434 1.78042 1.77059 5.56 .51015 .48366 .48100 .48606 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .48789 .46260 .46024 .45529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.28 1.81190 1.71410 1.65087 1.64350 5.72 .46669 .44254 .44045 .44528 3.32 1.77698 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 3.36 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.12 | 1.95276 | 1.84789 | 1.81300 | 1.80252 | 5.52 | .52170 | .49457 | .49176 | .49682 |
| 3.20 1.88220 1.78083 1.74787 1.73868 5.60 .49889 .47300 .47050 .47555 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .48789 .46260 .46024 .46529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.29 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.21 1.77698 1.66097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3,16 | 1.91748 | 1.81434 | 1,78042 | 1.77069 | 5.56 | .51015 | . 48366 | . 48100 | .48606 |
| 3.24 1.84699 1.74739 1.71540 1.70683 5.64 .49789 .46260 .46024 .4525 3.28 1.81190 1.71410 1.68305 1.67509 5.64 .49789 .46260 .46024 .4529 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61889 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.20 | 1.88220 | 1.78083 | 1.74787 | 1.73849 | 5.60 | 49889 | .47300 | 47050 | 477EEE |
| 3.28 1.81190 1.71410 1.68305 1.67509 5.68 .47716 .45245 .45023 .45528 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44545 3.38 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.24 | 1.84699 | 1.74739 | 1.71540 | 1.70683 | 5.64 | 48789 | 46260 | 46024 | -46520 |
| 3.32 1.77698 1.68097 1.65087 1.64350 5.72 .46669 .44254 .44045 .44549 3.36 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.28 | 1.81190 | 1.71410 | 1.68305 | 1.67509 | 5.68 | .47716 | .45245 | 45023 | 45528 |
| 3.38 1.74227 1.64806 1.61389 1.61210 5.76 .45647 .43287 .43091 .43594 | 3.32 | 1.77698 | 1.68097 | 1.65087 | 1.64350 | 5.72 | .46669 | .44254 | .44045 | 44549 |
| NACA - | 3.36 | 1.74227 | 1.64806 | 1.61889 | 1.61210 | 5.76 | .45647 | .43287 | .43091 | 43594 |
| | | | | | | | | | S. NI | NCL 7 |

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年 (中國) (**東**) (東京) (中国)

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TABLE II - VARIATION OF F WITH MACH NULBER M AND VELOCITY-PROFILE PARAMETER N - Concluded

| $\begin{bmatrix} \int_{1}^{M} \varphi dM_{1} \\ \underline{F} = \bullet \end{bmatrix}$ | |
|--|--|

| Mach | Veloc | ity-profi | le parame | ter, N | Mach | Veloci | ty-profil | e paramet | er, N |
|------|---------|-----------|-----------|---------|--------------|---------|-----------|-----------|---------|
| M | 5 | 7 | 9 | 11 | X | 5 | 7 | 9 | 11 |
| 5.80 | 0.44650 | 0.42343 | 0.42159 | 0.42661 | 8,20 | 0.13182 | 0.12511 | 0.12563 | 0.12845 |
| 5.84 | .43677 | .41422 | .41250 | .41750 | 8.24 | .12940 | .12281 | .12333 | .12612 |
| 5.88 | .42727 | .40523 | .40362 | .40860 | 8.28 | .12703 | .12056 | .12108 | .12384 |
| 5.92 | .40895 | .39040 | .38649 | .39143 | 8.36 | 12244 | .11620 | .11673 | .11942 |
| | | | | | | | | | |
| 6.00 | .40012 | .37953 | .37823 | .38314 | 8.40 | .12022 | .11409 | .11462 | .11727 |
| 6.04 | .39150 | .37137 | .37017 | .37505 | 8.44 | 11805 | .11203 | .11255 | .11517 |
| 6.08 | •38309 | .36341 | .36229 | .36715 | 8.49 | .11592 | .11000 | .11055 | .11312 |
| 6.16 | -36697 | -34804 | .34709 | .35190 | 8.56 | .11180 | .10609 | .10662 | 10914 |
| 0.10 | | 101001 | .01.00 | | | | | | |
| 6.20 | .35904 | .34063 | .33976 | .34454 | 8.50 | .10980 | .10419 | .10472 | .10721 |
| 6.24 | .35141 | .33340 | .33261 | .33735 | 8.64 | .10784 | .10233 | .10286 | .10532 |
| 6.28 | .34396 | .32634 | .32562 | .33033 | 8,68 | .10593 | .10051 | .10104 | +10347 |
| 0.32 | -33668 | 131940 | .31879 | .02047 | 0.76 | 10200 | .09673 | 09920 | .10103 |
| 0,00 | 0.6306 | .01676 | .01210 | .01011 | 0.10 | • 10222 | .03030 | | |
| 6.40 | .32264 | .30615 | .30562 | .31022 | 8.90 | .10042 | .09527 | .09580 | .09813 |
| 6.44 | .31587 | .29973 | .29926 | .30383 | 8.84 | .09866 | .09360 | .09412 | .09643 |
| 6.48 | .30926 | .29347 | .29306 | .29759 | 8.88 | .09693 | .09196 | .09248 | .09476 |
| 6.52 | .30281 | .28735 | .28700 | .29149 | 8.92 | .09524 | .09035 | .09087 | .09312 |
| 0.00 | .29020 | *58T28 | .28101 | • 60000 | 0.30 | •02003 | .00078 | +00930 | .09102 |
| 6.60 | 29035 | .27554 | .27529 | .27971 | 9.00 | .09197 | .08724 | .08775 | .08994 |
| 6.64 | .28434 | ,26985 | .26964 | .27402 | 9.04 | .09038 | .08573 | .08624 | .08840 |
| 6.68 | .27847 | .26429 | .26412 | .26846 | 9.08 | .08882 | .08425 | .08476 | .08689 |
| 6.72 | .27274 | 25885 | .25873 | .26303 | 9.12 | .08730 | .08280 | .08331 | .08541 |
| 0.70 | *S0112 | .25555 | .20347 | .20112 | a. 10 | .08580 | •00130 | .00100 | •00080 |
| 6.80 | .26168 | .24836 | .24832 | .25254 | 9.20 | .08434 | .07999 | .08049 | .08254 |
| 6.84 | .25634 | .24330 | .24330 | .24747 | 9.24 | .08290 | .07862 | .07912 | .08115 |
| 6.88 | .25113 | .23836 | .23839 | .24252 | 9.28 | .08150 | .07728 | .07778 | .07978 |
| 6.92 | .24603 | .23352 | .23359 | .23768 | 9.32 | .08012 | .07597 | .07647 | .07844 |
| 6.96 | .24106 | .22881 | .25830 | •20295 | 9.36 | .07877 | •07469 | .07518 | .07713 |
| 7.00 | .23620 | .22419 | .22432 | 22833 | 9.40 | .07744 | .07343 | .07392 | .07584 |
| 7.04 | .23145 | .21969 | .21984 | .22381 | 9.44 | .07614 | .07220 | .07268 | .07458 |
| 7.08 | .22681 | .21529 | .21547 | .21339 | 9.48 | .07487 | .07099 | .07147 | .07334 |
| 7.12 | .22227 | .21099 | .21119 | .21508 | 9.52 | .07362 | .06980 | .07028 | .07213 |
| 7.16 | .21785 | .20679 | .20/01 | .\$1086 | 9.00 | .07240 | .06864 | *00AIT | .07094 |
| 7.20 | .21352 | -20268 | .20293 | .20673 | 9.60 | .07120 | .06750 | .06797 | .06977 |
| 7.24 | .20929 | .19866 | .19894 | .20270 | 9.64 | .07002 | .06638 | .06685 | .06862 |
| 7.28 | .20515 | .19474 | .19504 | .19875 | 9.68 | .06887 | .06528 | .06575 | .06750 |
| 7.32 | .20111 | .19091 | .19122 | .19490 | 9.72 | .06774 | .06421 | .06467 | .06640 |
| 7.36 | •19717 | .18716 | .18749 | •19112 | 9.76 | •06663 | •06319 | *0626T | .06532 |
| 7.40 | .19331 | .18350 | .18385 | .18744 | 9,80 | .06554 | .06212 | .06257 | .06426 |
| 7.44 | 18953 | .17992 | 18028 | .18383 | 9.84 | .06448 | .06110 | .06155 | .06322 |
| 7.48 | 18585 | .17642 | .17680 | .18031 | 9.89 | .06343 | .06011 | .06055 | ,06220 |
| 7.52 | .18224 | .17300 | .17339 | .17686 | 9.92 | .06240 | .05913 | .05957 | .06120 |
| 7.56 | .17872 | .16965 | .17005 | .17349 | 9.96 | .06140 | *02918 | .09801 | .06021 |
| 7.60 | .17527 | .16638 | .16680 | .17019 | 10.00 | .06041 | .05724 | .05767 | .05925 |
| 7.64 | .17190 | .16318 | .16361 | .16696 | | | | | |
| 7.68 | .16861 | .16005 | .16049 | .16380 | | | | | |
| 7.72 | .16539 | .15700 | 15744 | .16072 | | | | | |
| 7.76 | .16224 | .15400 | .13446 | .15770 | | | | | |
| 7,80 | .10916 | .15108 | .15154 | .15474 | | | | | |
| 7.84 | .15615 | .14822 | .14869 | .15185 | | | | | |
| 7.88 | .15320 | .14542 | .14590 | .14902 | | | | | |
| 7.92 | .15032 | .14268 | .14317 | .14625 | | | | | |
| 7,96 | .14750 | .14000 | .14050 | .14354 | | | | | |
| 8.00 | 14474 | .13738 | .13788 | -14089 | | | | | |
| 8.04 | 14204 | 13482 | .13532 | .13829 | | | | | |
| 8.08 | .13940 | .13231 | .13282 | .13575 | | | | | |
| 8.12 | .13682 | .12986 | .13037 | .13327 | | | | | |
| 8.16 | .13429 | .12746 | .12797 | .13083 | | | | | |

6. 7. . . .

(b) Supersonic flow - Concluded.

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TABLE III - VARIATION OF <u>I</u> WITH MACH NUMBER

M AND VELOCITY-PROFILE PARAMETER N

 $\underline{I} \equiv \int_{0.100}^{M} \Psi_{am} = \int_{0.100}^{M_1} \Phi^{dM_1} dM_1$

(a) Subsonic flow.

| Mach | Velo | city-profile | e parameter, | N | |
|-------|------------|--------------|--------------|------------|--|
| M | 5 | 7 | 9 | 11 | |
| 0.100 | 0 | 0 | 0 | 0 | |
| •200 | 4.91759 | 5.68978 | 6.55166 | 7.44960 | |
| •300 | 28.29925 | 31.37242 | 35.27697 | 39.50493 | |
| •400 | 94.20004 | 101.16754 | 111.76809 | 123.75784 | |
| •500 | 235.22199 | 246.43462 | 268.52546 | 294.70417 | |
| •600 | 489.50037 | 502.58784 | 541.52109 | 590.03396 | |
| •700 | 897.01022 | 905.54650 | 966.53830 | 1046.79233 | |
| •800 | 1495.82853 | 1488.32157 | 1575.78838 | 1697.78027 | |
| •900 | 2320.09720 | 2278.20734 | 2395.19839 | 2568.97270 | |
| 1.000 | 3408.95820 | 3294.78879 | 3442.57460 | 3677.72994 | |

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TABLE III - VARIATION OF \underline{I} WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued

| <u>I</u> ≢ | ₩ ¥am | $\int_{1}^{M_{1}} \varphi dM_{1}$ | dM1 |
|------------|----------|-----------------------------------|-----|
|------------|----------|-----------------------------------|-----|

| Nach | 1 | | | | Kach | | | · · · · | |
|----------|----------|-----------|--------------|----------|----------|-----------|----------|------------|-----------|
| number | Velo | | le paramete: | r, N | number | Velo | | e paramete | r, N |
| <u> </u> | 5 | 7 | | 11 | <u> </u> | 5 | 7 | 9 | 11 |
| 1.00 | .37362 | 45064 | .52988 | 61009 | 3.40 | 48.70297 | 54.31373 | 61.15168 | 68.48143 |
| 1.08 | .77928 | .93786 | 1.10143 | 1.26716 | 3.48 | 50.12821 | 55.63334 | 62.81947 | 70.31840 |
| 1.12 | 1.21723 | , 1.46173 | 1.71458 | 1.97102 | 3.52 | 50.82340 | 56.57342 | 63.63090 | 71.21173 |
| 1.10 | 1.68/51 | 2.02209 | 2.36903 | E. 12123 | 3.30 | 51.50703 | 57.30045 | 04.42775 | 72.08850 |
| 1.20 | 2.18998 | 2.61859 | 3.06422 | 3,51709 | 3.60 | 52.17917 | 58.01454 | 65.20990 | 72.94888 |
| 1.24 | 2.72436 | 3.25067 | 3.79940 | 4.35764 | 3.64 | 52.83989 | 58.71579 | 65.97758 | 73.79303 |
| 1.32 | 3.68683 | 4.61956 | 5.38577 | 6.16799 | 3.72 | 54.12742 | 60.08033 | 67.47012 | 75.43341 |
| 1.36 | 4.51355 | 5.35243 | 6.23454 | 7.13490 | 3.76 | 54.75443 | 60.74387 | 68.19533 | 76.23005 |
| 1.40 | 5 16047 | 6.11907 | 7,11850 | 8 14077 | 3.90 | 55.37041 | 61.39513 | 68.00674 | 77 01197 |
| 1.44 | 5.95359 | 6.91419 | 8.03609 | 9.18377 | 3.94 | 55.97547 | 62.03425 | 69.60453 | 77.77728 |
| 1.48 | 6.56480 | 7.73941 | 8.98564 | 10.26195 | 3.88 | 56.56973 | 62.66141 | 70.28889 | 78.52839 |
| 1.52 | 7.30191 | 8.59223 | 9.96540 | 11.37328 | 3.92 | 57.15332 | 63.27675 | 70,96002 | 79.26454 |
| 1.00 | | | 10001001 | 12101201 | 1 | | | | |
| 1.50 | 8.54867 | 10.37442 | 12.00910 | 13.68688 | 4.00 | 58.28903 | 64.47263 | 72.26340 | 80.69371 |
| 1.68 | 9.65561 | 12.24773 | 13.06724 | 14.98477 | 4.04 | 50.38368 | 65.62327 | 72.89605 | 81.38708 |
| 1.72 | 11.32950 | 13.21432 | 15.25130 | 17.35158 | 4.12 | 59.91596 | 66.18207 | 74.12425 | 82.73257 |
| 1.76 | 12.19354 | 14.19861 | 16.37230 | 18.61605 | 4.16 | 60.43840 | 66.73009 | 74.72023 | 83.38517 |
| 1,80 | 13-07368 | 15,19888 | 17.51001 | 19,89929 | 4.20 | 60.95116 | 67.26750 | 75.30442 | 84.02486 |
| 1.94 | 13.96843 | 16.21344 | 18.66250 | 21.19611 | 4.24 | 61.45439 | 67.79448 | 75.87701 | 84.65128 |
| 1.88 | 14.97633 | 17.24063 | 19.92788 | 22.50739 | 4.28 | 61.94823 | 68.31122 | 76.43822 | 85.26526 |
| 1.92 | 16.72581 | 19.32632 | 22.18988 | 25.15205 | 4.36 | 62.90837 | 69.31467 | 76.98824 | 85.86683 |
| | | | | | | | | | |
| 2.00 | 17.66458 | 20.38167 | 23.38296 | 26.50143 | 4.40 | 63.37497 | 69.80174 | 78.05557 | 87.03369 |
| 2.08 | 19.56337 | 22.50986 | 25.78484 | 29.19493 | 4.48 | 64.28196 | 70.27927 | 79.08065 | 88.15374 |
| 2.12 | 20.52078 | 23.57983 | 26.99043 | 30.54548 | 4.52 | 64.72266 | 71.20643 | 79.57785 | 88.69678 |
| 2.16 | 21.43190 | 24.65190 | 28.19710 | 31.89633 | 4.56 | 65.15504 | 71.65643 | 80,06509 | 89.22879 |
| 2.20 | 22.44553 | 25.72478 | 29.40346 | 33.24592 | 4.60 | 65.57925 | 72.09758 | 80.54256 | 89.75000 |
| 2.24 | 23.41054 | 26.79727 | 30.60815 | 34.59277 | 4.64 | 65.99543 | 72.53007 | 81.01046 | 90.26064 |
| 2.28 | 24.37584 | 27.56818 | 31.80990 | 35.93540 | 4.68 | 66.40372 | 72.95406 | 81.46898 | 90.76092 |
| 2,36 | 26.30329 | 30.00100 | 34.19982 | 38.60324 | 4.76 | 67.19725 | 73.77721 | 82.35864 | 91.73122 |
| a 40 | 00.00767 | 1 | 75 735 03 | | 1 00 | 67 60070 | 74 19440 | 00 00010 | |
| 2.44 | 29.22027 | 32.11523 | 36.56449 | 41.23967 | 4.80 | 67.96099 | 74.17059 | 82.79016 | 92.20168 |
| 2.48 | 29.17271 | 33.16314 | 37.73495 | 42,54351 | 4.88 | 68.33203 | 74.95229 | 83.62747 | 93.11419 |
| 2.52 | 30.12008 | 34.20384 | 38.89634 | 43.63652 | 4.92 | 68.69604 | 75.32871 | 84.03361 | 93.55664 |
| 4.00 | 51.00100 | 35.23660 | 40.04787 | 43.11/83 | 4.90 | 09.00.010 | 12.09110 | 04.43104 | 92.99017 |
| 2.60 | 31.99680 | 36.26076 | 41.18884 | 46.38674 | 5.00 | 69.40352 | 76.05958 | 84.82172 | 94.41494 |
| 2.64 | 32.92488 | 37.27568 | 42.31860 | 47.64249 | 5.04 | 69.74727 | 76.41433 | 85.20404 | 94.83117 |
| 2.72 | 34.75767 | 39.27563 | 44.54215 | 50.11209 | 5.12 | 70.41540 | 77.10317 | 85.94604 | 95.63865 |
| 2.76 | 35.66137 | 40.25966 | 45.63491 | 51.32485 | 5.16 | 70.74003 | 77.43754 | 86.30602 | 96.03027 |
| 2,80 | 36,55601 | 41,23249 | 45.71441 | 52.52229 | 5.20 | 71-05854 | 77.76540 | 86.65887 | 96.41405 |
| 2.84 | 37.44120 | 42.19376 | 47.78028 | 53.70403 | 5.24 | 71.37106 | 78.08690 | 87.00473 | 96.79015 |
| 2.88 | 38.31659 | 43.14313 | 49.83216 | 54.86972 | 5.28 | 71.67772 | 78.40217 | 87.34379 | 97.15876 |
| 2.92 | 40.03673 | 45.00501 | 49,86977 | 57,15178 | 5.32 | 72.27390 | 78.71132 | 87.67617 | 97.52003 |
| | | | | | | | | 00.00200 | 0.001410 |
| 3.00 | 40.88095 | 45.91705 | 51.90120 | 58.26768 | 5.40 | 72.56365 | 79.31182 | 88.32144 | 98.22115 |
| 3.08 | 42,53662 | 47.70240 | 53.87308 | 60.44941 | 5.44 | 73.12701 | 79.88940 | 88.94165 | 98,89477 |
| 3.12 | 43.34771 | 48.57544 | 54.83635 | 61.51300 | 5.52 | 73.40084 | 80.16939 | 89.24269 | 99.22164 |
| 3.16 | 44.14744 | 49.43524 | 55.78437 | 62.56031 | 5.56 | 73.66958 | 80.44501 | 89.53788 | 99.54208 |
| 3.20 | 44.93572 | 50.28173 | 56.71711 | 63.59031 | 5.60 | 73.93334 | 80.71458 | 89.82734 | 99.85623 |
| 3.24 | 45.71245 | 51.11487 | 57.63455 | 64.60300 | 5.64 | 74.19222 | 80.37961 | 90.11119 | 100.16423 |
| 3.28 | 46.47758 | 51.93463 | 58.53669 | 65.59840 | 5.58 | 74.44633 | 81,23930 | 90.38955 | 100.46622 |
| 3.36 | 47.97285 | 53.53403 | 60.29520 | 67.53753 | 5.76 | 74.94058 | 81.74397 | 90.93026 | 101.05266 |

(b) Supersonic flow

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 TABLE III - VARIATION OF I WITH MACH NUMBER M AND VELOCITY-PROFILE

 PARAMETER N - Concluded

 $\begin{bmatrix} \underline{I} \\ \underline{I} \end{bmatrix} \begin{bmatrix} M \\ \Psi_{am} \\ \Psi_{am} \end{bmatrix} \begin{bmatrix} M_{1} \\ \varphi dM_{1} \\ dM_{1} \end{bmatrix}$

| (b) | Superson | ic f | low | - | Concluded. |
|-----|----------|------|-----|---|------------|
|-----|----------|------|-----|---|------------|

| Mach | Valor | ity-profile | narsmater | . N | Mach | Veloc | ity-profil | e parameter | , N |
|----------|----------|-------------|-------------|-----------|--------------|----------|------------|-------------|---|
| number | Aeroc | rej-prorite | - peramover | 1 | number v | 5 | 7 | 9 | 11 |
| <u> </u> | 5 | | ¥ . | 1 | | | | 100 0500 | 111 54705 |
| 5.80 | 75.18093 | 81.98918 | 91.19285 | 101.33738 | 8.20 | 84.00329 | 90.88042 | 100.65004 | 111.54705 |
| 5.94 | 75.41687 | 82.22976 | 91.45040 | 101.61658 | 0.24 | 04 17030 | 90.90302 | 100 82709 | 111.73717 |
| 5.88 | 75.64849 | 82.46581 | 91.70303 | 101.89038 | 0.20 | 84 25501 | 91.13026 | 100.91352 | 111.62996 |
| 5.92 | 75.87589 | 82.69744 | 91.95086 | 102.10893 | 9.36 | 84.33637 | 91.21095 | 100.99860 | 111.92128 |
| 5.90 | 10-03872 | 82.92413 | 85.19331 | 102.42201 | | | | | |
| e 00 | 76.31836 | 83,14779 | 92.43247 | 102.68065 | 8.40 | 84.41650 | 91.29039 | 101.08234 | 112.01116 |
| 6.04 | 76.53361 | 83,36669 | 92.66647 | 102.93406 | 8.44 | 84.49541 | 91.36861 | 101.16477 | 112.09962 |
| 6.08 | 76.74498 | 83.58153 | 92.89606 | 103.18265 | 8.48 | 84.57314 | 91.44563 | 101.24592 | 112.16670 |
| 6.12 | 76.95254 | 63.79239 | 93.12132 | 103.42652 | 8.52 | 84.64970 | 91.52146 | 101.32581 | 112.27241 |
| 6.16 | 77.15636 | 83.99935 | 93.34236 | 103.66578 | 8.56 | 64.72512 | 91.59613 | 101.40446 | 112.35678 |
| | | | | 107 00050 | 0.00 | 04 70042 | 01 66066 | 101 48100 | 112.43983 |
| 6.20 | 77.35653 | 84.20249 | 93.55920 | 103.90052 | 0.00 | 84 07261 | 91.74208 | 101.55815 | 112,52159 |
| 6.24 | 77.55312 | 84.40190 | 90.11210 | 104.15085 | 8.68 | 84.94472 | 91,81341 | 101.63323 | 112.60209 |
| 6.28 | 77.74021 | 94.09707 | 94 12609 | 104.57860 | 8.72 | 85.01576 | 91.68366 | 101.70716 | 112.68136 |
| 4 36 | 79.12218 | 84.97857 | 94.38735 | 104.79 24 | 8.76 | 85.08575 | 91.95284 | 101.77996 | 112.75941 |
| 0.00 | 10,12210 | 0 | | 1 | | l. | | | |
| 6.40 | 78.30519 | 85.16384 | 94.58489 | 105.00983 | 8.80 | 85.15472 | 92.02098 | 101.85165 | 112.83627 |
| 6.44 | 78.48497 | 85.34575 | 94.77880 | 105.21946 | 8.84 | 85.22267 | 92.08810 | 101.92226 | 112.91195 |
| 6.48 | 78,66160 | 85.52438 | 94.96917 | 105.42521 | 8,89 | 85.28963 | 92.15422 | 101.99180 | 112.98649 |
| 6.52 | 78.83513 | 85.69979 | 95.15606 | 105.62717 | 8,92 | 85.35562 | 92.21937 | 102+06029 | 113.03909 |
| 6.56 | 79.00563 | 85.87205 | 95.73954 | 105,82543 | 8.96 | 00.42000 | 92.20000 | 102+12/10 | 110.10518 |
| | 70 19377 | 06 043 07 | 05 51040 | 106-02006 | 9.00 | 85.48476 | 92.34678 | 102,19422 | 113.20340 |
| 6.60 | 79.17517 | 06 00730 | 05 60658 | 106.21112 | 9.04 | 85.54794 | 92.40908 | 102.25968 | 113.27354 |
| 0.04 | 79.00719 | 86.37060 | 95.87029 | 106.39871 | 9.08 | 85.61020 | 92.47047 | 102.32418 | 113.34263 |
| 6.72 | 79.65853 | 86.53092 | 96.04087 | 106.58290 | 9.12 | 85.67158 | 92.53096 | 102.38772 | 113.41069 |
| 5.75 | 79.81475 | 36,68839 | 96.20638 | 106.76375 | 9.16 | 85.73208 | 92.59056 | 102.45032 | 113.47773 |
| | | ł | | | | | | 100 51001 | 117 64770 |
| 6.80 | 79,96829 | 86.84309 | 96.37290 | 106.94134 | 9.20 | 85.79172 | 92.54930 | 102.51201 | 113.54578 |
| 6.84 | 80.11921 | 86,99508 | 96.53448 | 107.11573 | 9.29 | B5.0002 | 92.76424 | 102-63270 | 113.67298 |
| 6.88 | 80.26755 | 87.14440 | 96.69320 | 107 45521 | 9.32 | 85,96563 | 92.82046 | 102.69171 | 113.73616 |
| 6.92 | 80.41337 | 87.29114 | 97.00227 | 107.62043 | 9.36 | 86.02198 | 92.87588 | 102.74986 | 113.79841 |
| 0.90 | 80.03072 | 01.40022 | 31100221 | | | | | | |
| 7.00 | 80.69865 | 87.57695 | 97.15274 | 107.78272 | 9.40 | 86.07754 | 92.93051 | 102.80717 | 113.85976 |
| 7.04 | 80.83620 | 87.71616 | 97.30057 | 107.94214 | 9.44 | 86.13232 | 92.98436 | 102.86366 | 113.92021 |
| 7.08 | 80.97241 | 87.85296 | 97.44561 | 108.05874 | 9,48 | 86.18634 | 93.03744 | 102.91934 | 113.97979 |
| 7.12 | 81.10634 | 87.98742 | 97.58852 | 108.25260 | 9.52 | 80.23901 | 93.08977 | 102.9/122 | 114 09637 |
| 7,16 | 81.23802 | 88,11958 | 97.72876 | 108.40376 | 8.90 | 00.29215 | 93.14130 | 100.02001 | 114.0500. |
| 1 2 20 | 01 36751 | 98.24947 | 97.86657 | 108.55228 | 9.60 | 86.34397 | 93.19223 | 103.08163 | 114.15342 |
| 7.24 | 81.49466 | 88.37715 | 98.00200 | 108.69822 | 9.64 | 86.39508 | 93.24239 | 103.13420 | 114.20964 |
| 7.28 | 81,62010 | 88.50266 | 98.13510 | 106.84162 | 9.68 | 86.44548 | 93.29184 | 103.18603 | 114.26506 |
| 7.32 | 81.74327 | 88.62605 | 98.26592 | 108,98254 | 9.72 | 86.49519 | 93.34060 | 103.23713 | 114.31969 |
| 7.36 | 81.86441 | 88.74737 | 98.39451 | 109,12103 | 9.76 | 86.54423 | 93.28868 | 103.28751 | 114.37355 |
| | | | | 100 00014 | 0.00 | 00 50001 | 01 43610 | 103 33710 | 114.42665 |
| 7.40 | 81.98356 | 88.86664 | 98.52090 | 109.25714 | 9.80 | 00.09201 | 93.43010 | 103.39610 | 114.47900 |
| 7.44 | 82.10077 | 88.98391 | 98.04514 | 109.39093 | 9.04 6 22 | 86 69740 | 93.52897 | 103-43445 | 114.53061 |
| 7.48 | 82.21606 | 88.03823 | 98.70720 | 109.65171 | F 9,92 | 86.73384 | 93.57445 | 103.48207 | 114.58150 |
| 7.52 | 82.02949 | 99.21203 | 99,00540 | 109.77878 | 9,96 | 86.77965 | 93.61932 | 103.52903 | 114.63169 |
| 1 1.00 | 02.11100 | 00102111 | | | | 1 | 1 | | |
| 7.60 | 82.55087 | 89.43381 | 99.12147 | 109.90370 | 10.00 | 86.82485 | 93.66357 | 103.57534 | 114.68118 |
| 7.64 | 82.65889 | 89.54167 | 99.23560 | 110.02652 | E . | | | | |
| 7,68 | 82.76517 | 89.64776 | 99.34783 | 110.14728 | | | 1. | | |
| 7.72 | 82.86975 | 89.75211 | 99.45820 | 110.26601 | | | 1 | | |
| 7.76 | 82.97266 | 89.85476 | 99.56674 | 110.38276 | i | 1 | | 1 | 1 |
| 7 00 | 03 07304 | 80.05573 | 99.67350 | 110.49758 | | | 1 | | |
| 7.94 | 83,17361 | 90,05506 | 99,77851 | 110.61049 | | | 1 | 1 | |
| 7.89 | 83.27171 | 90.15279 | 99.88160 | 110,72153 | | | 1 | 1 | 1 |
| 7.92 | 83.36827 | 90.24895 | 99.98339 | 110.83074 | 1 | | | 1 | 1 |
| 7.96 | 83.46332 | 90.34356 | 100.08333 | 110.93817 | | | | | |
| | | | | | | | | 1 | |
| 8.00 | 83.55688 | 90.43665 | 100.16165 | 111.04385 | ij. | 1 | | | 1 |
| 8.04 | 83.64898 | 90.52827 | 100.51838 | 111 05007 | H | 1 | 1 | 1 | 1 |
| 8.08 | 83.73964 | 90.61843 | 100.44701 | 111.35064 | ų. | | | 1 | |
| 0.14 | 83.01677 | 90.79448 | 100.55936 | 111.44966 | 1 | | 1 | | |
| 0.10 | 00.91011 | 30.18110 | 100.00000 | | <u> </u> | 1 | . | | + · · · · · · · · · · · · · · · · · · · |

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TABLE IV - VARIATION OFJWITH MACH NUMBERMANDVELOCITY-PROFILEPARAMETERN



| Mach | Veloci | Velocity-profile parameter, N | | | | | | | | | |
|-------------|----------|-------------------------------|----------|--------|--|--|--|--|--|--|--|
| number M | 5 | 7 | 9 | 11 | | | | | | | |
| 0.100 | 0 | 0 | 0 | 0 | | | | | | | |
| •200 | .3985909 | .5004917 | .6032484 | .70638 | | | | | | | |
| •300 | •4514030 | .5717316 | •6925810 | .81366 | | | | | | | |
| •400 | .4672274 | •5939497 | •7210622 | .84835 | | | | | | | |
| •500 | •4739628 | .6036716 | .7337139 | .86391 | | | | | | | |
| .600 | .4774799 | .6088542 | •7405334 | .87235 | | | | | | | |
| •700 | •4795857 | .6120071 | •7447172 | .87755 | | | | | | | |
| .800 | •4809780 | .6141182 | .7375368 | .88108 | | | | | | | |
| .900 | .4819700 | •6156395 | .7495786 | .88364 | | | | | | | |
| 1.000 | .4827112 | .6168013 | .7511439 | .88560 | | | | | | | |
| | | | | NACA_ | | | | | | | |

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TABLE IV - VARIATION OF J WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued

 $\begin{bmatrix} \mathbf{J} & \mathbf{W} & -\int_{1}^{\mathbf{W}_{1}} \phi d\mathbf{M}_{1} \\ \mathbf{Y}_{\mathrm{BH}} & \mathbf{e}^{-\int_{1}^{\mathbf{W}_{1}} \phi d\mathbf{M}_{1}} \\ \mathbf{M}_{1} \end{bmatrix}$

| Nach Vela number 5 1.00 0 | city-profile 7 | parameter, 9 | N 11 | number | 5 | 7 | 9 | |
|---------------------------------|-------------------------|------------------------------|----------|--------|----------|-----------|----------|------------|
| N 5 1.00 0 | 7 | 9 | 1.1 | | | | | 11 |
| 1.00 0 | 10 | | | - 10 | 11 26709 | 13-71057 | 16-00192 | 18.21604 |
| | | 0 | 66251 | 3.44 | 11.51844 | 14.01026 | 16.34268 | 18.59429 |
| 1.04 .3423 | .41434 | .48806 | 1 08160 | 3.48 | 11.77598 | 14.31702 | 16.69113 | 18.98070 |
| 1.08 .6571 | .79616 | 1,35600 | 1.56347 | 3.52 | 12.03991 | 14.63109 | 17.04750 | 19.37555 |
| 1.12 .9484 | 1.48034 | 1.74585 | 2.01327 | 3.56 | 12.31044 | 14.95270 | 17.41206 | 19.77910 |
| 1.10 1.2190 | | | | | 10 60003 | 15 00000 | 17.78507 | 20,19162 |
| 1.20 1.4732 | 1.78986 | 2.11156 | 2.43531 | 3.60 | 12.58781 | 15.61952 | 18.16679 | 20.61339 |
| 1.24 1.7120 | 2.08151 | 2.45632 | 2.83323 | 3.04 | 12.0/222 | 15.96523 | 18.55749 | 21.04468 |
| 1.28 1.9377 | 2.35762 | 2.78283 | 3.56858 | 3.72 | 13.46308 | 16.31949 | 18.95745 | 21.48579 |
| 1.32 2.1520 | 2.62018 | 3 39003 | 3,91092 | 3.76 | 13.77000 | 16.68256 | 19.36695 | 21.93701 |
| 1.36 2.3565 | 2.07007 | 5.0.0000 | | | | | | 00 30064 |
| 1 40 2.5524 | 3.11123 | 3.67441 | 4.23910 | 5.80 | 14.08491 | 17.05472 | 19.78627 | 22.09004 |
| 1.44 2.7407 | 5 3.34249 | 3.94805 | 4.55482 | 3.84 | 14.40805 | 17.43023 | 20.65557 | 23.35437 |
| 1.48 2.9224 | 5 3.56578 | 4.21225 | 4.85959 | 3.98 | 15 08005 | 18-22846 | 21,10616 | 23.84910 |
| 1.52 3.0983 | 7 3.78209 | 4.46816 | 5 44134 | 3.96 | 15.42943 | 18.63976 | 21.56778 | 24.35549 |
| 1.56 3.2692 | 3,99228 | 8 4.71679 | 0144104 | | 10111111 | | | |
| | A 10714 | 4.05905 | 5.72052 | 4.00 | 15.78809 | 19.06158 | 22.04075 | 24.87388 |
| 1.60 3.435 | 5 4.39734 | 5.19575 | 5.99318 | 4.04 | 16.15630 | 19.49423 | 22.52540 | 25.40460 |
| 1.69 3.757 | 4.59350 | 5.42761 | 6,26014 | 4.08 | 16.53434 | 19,93801 | 23.02205 | 20.94/98 |
| 1.72 3.9142 | 3 4.78620 | 5.65528 | 6.52214 | 4.12 | 16.92250 | 20.38323 | 24.05270 | 27.07416 |
| 1.76 4.068 | 6 4.97594 | 5.87935 | 6.77986 | 4.15 | 14.95108 | 62000+03 | | |
| | | | a 01100 | 4.20 | 17,73039 | 21.33942 | 24.58740 | 27.65767 |
| 1.80 4.220 | 6 5.16317 | 6.10036 | 7.00392 | 4.24 | 18,15072 | 21.83101 | 25.13550 | 28.25529 |
| 1.94 4.370 | 9 5.34833 | 6 53514 | 7.53329 | 4.28 | 18.58239 | 22,33541 | 25.69736 | 28,86738 |
| 1.68 4.519 | g 5.00101 e 5.71307 | 6.74977 | 7.77959 | 4.32 | 19.02573 | 22.85297 | 26.27335 | 29.49433 |
| 1.92 4.000 | 7 5.89514 | 6.96310 | 8.02423 | 4.36 | 19.48106 | 23,38406 | 26,86385 | 303031 |
| 1.30 4.010 | | | 1 | 1 | 10 04070 | 03 02004 | 97.46924 | i 30.79441 |
| 2.00 4.962 | 8 6.07563 | 7.17550 | 8.26762 | 4.40 | 19.94872 | 23.92904 | 28.08993 | 31.46835 |
| 2.04 5.108 | 5 6.25574 | 7.38730 | 8.51015 | 4.48 | 20.92240 | 25.06221 | 28,72633 | 32.15878 |
| 2.08 5.255 | 1 6.43575 | 7.59883 | 8.75219 | 4.52 | 21.42913 | 25.65118 | 29.37884 | 32.86611 |
| 2.12 5.402 | 8 6.51593 | 8.02224 | 9.23615 | 4.56 | 21.94961 | 26.25561 | 30.04788 | 33.59078 |
| 2.16 5.549 | 0.19031 | 0.02204 | 1 | | | | | 14 31305 |
| 0.00 5.697 | 6.97773 | 8.23469 | 9.47870 | 4.60 | 22.48422 | 26.87591 | 30,73389 | 39,00020 |
| 2.24 5.845 | 7,15984 | 8.44798 | 9.72202 | 4.64 | 23.03334 | 27.5.250 | 32.15856 | 35.87326 |
| 2.28 5.995 | 1 7.34305 | 8.66238 | 9.96639 | 4.58 | 23.39730 | 28, 63628 | 32.89814 | 36.67179 |
| 2.32 6.146 | .0 7.52756 | 8,87913 | 10.21210 | 4.76 | 24.77170 | 29.52436 | 5.65650 | 37.48995 |
| 2.36 6.298 | 4 7.71359 | 9.09546 | 10.49840 | 9.10 | 240/12/0 | | | |
| | | 0 31461 | 10.70855 | 4.80 | 25.38285 | 30,23051 | 34.43412 | 38.32824 |
| 2.40 6.451 | | 9.53580 | 10.95979 | 4.84 | 26.01055 | 30,95520 | 35.23148 | 39.18715 |
| 2.44 0.007 | 8.2827 | 9.75924 | 11.21337 | 4.98 | 26.65524 | 31.69890 | 36.04907 | 40.06717 |
| 2.52 6.923 | 8.4768 | 9.98515 | 11.46953 | 4.92 | 27.31735 | 32.46208 | 36.88739 | 40.90002 |
| 2.56 7.085 | 4 8.67340 | 0 10.21373 | 11.72851 | 4.96 | 27.99737 | 33.24527 | 91*140AA | 41.00200 |
| | | | 11 00054 | 6 00 | 29.60572 | 34.04895 | 38.62636 | 42.83918 |
| 2.60 7.248 | 8.8727 | 2 10.44520 5 10.47079 | 12.25584 | 5.04 | 29,41291 | 34.87368 | 39.53207 | 43.80899 |
| 2.64 7.415 | 0 2000 | 10.01747 | 12.52463 | 5.08 | 30.14942 | 35.71996 | 40.45867 | 44.80262 |
| 2.68 7.584 | 9,4884 | 6 11.15906 | 12.79713 | 5.12 | 30.90569 | 36.58828 | 41.40866 | 45.82057 |
| 2.76 7.030 | 58 9.7003 | 0 11.40417 | 13.07358 | 5.16 | 31.68227 | 37.47924 | 42.38265 | 46.86348 |
| 1 2010 1000 | | | | | | | 43 30100 | 47.93104 |
| 2.60 8.108 | 46 9.9157 | 5 11.65320 | 13.35420 | 5.20 | 32.47967 | 38.39341 | 44.40407 | 49.02656 |
| 2.84 8.289 | 54 10.1350 | 0 11.90636 | 13.63920 | 5.24 | 33.29842 | 40.29369 | 45.45455 | 50.14800 |
| 2.88 8.474 | 28 10.3582 | 3 12.16385 | 13,92880 | 5.30 | 35.00220 | 41.28097 | 46.53052 | 51.29683 |
| 2.92 8.662 | 54 LC.5856 | 8 12-60265 | 14.52271 | 5.36 | 35.88826 | 42.29380 | 47.63349 | 52.47367 |
| 5.96 9.954 | 32 10.5175 | 12.03200 | 1 | 1 | | | | |
| 3.00 9.050 | 60 11.0536 | 7 12.96438 | 14.82746 | 5.40 | 36.79790 | 43.33284 | 48.76416 | 53.67922 |
| 3.04 9.250 | 75 11.2947 | 0 13.24127 | 15.13771 | 5.44 | 37.73166 | 44.39866 | 49.92312 | 56 1700 |
| 3.08 9.455 | 19 11.5406 | 7 13.52355 | 15.45369 | 5.48 | 38.69017 | 45.49196 | 52.32860 | 57.4745 |
| 3.12 9.664 | 11 11.7917 | 8 13.81143 | 15.77564 | 5.52 | 39.67398 | 40.01000 | 53.57667 | 58.8015 |
| 3.16 9.97 | 68 12.0482 | 2 14.10511 | 10.103/8 | 5.56 | 10.50077 | -1110001 | 00.007 | 1 |
| | 00 10 2100 | 1 14 40493 | 16.43835 | 5.60 | 41.72016 | 48.94326 | 54.85572 | 60.1606 |
| 3.20 10.096 | 40 12.5102 | 4 14.71061 | 16.77958 | 5.64 | 42,76378 | 50.15313 | 56.16656 | 61.5526 |
| 3.29 10.54 | 11 12.9516 | 2 15.02327 | 17.12772 | 5.68 | 43.87528 | 51.39386 | 57.50992 | 62.9782 |
| 3.32 10.78 | 12 13.1314 | 7 15.34245 | 17.48300 | 5.72 | 44.99531 | 52.66623 | 58.88652 | 64.4381 |
| 3.36 11.02 | 71 13.4177 | 2 15.66859 | 17.84569 | 5.76 | 46.14455 | 53.97092 | 60.29/14 | 03.9331 |
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(b) Supersonic flow.

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TABLE IV - VARIATION OF J WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Concluded



(b) Supersonic flow - Concluded.

| Mach | Veloci | ty-profile | parameter, | N | Mach | Velo | city-profil | e parameter | , N |
|--------------|-----------|-------------|--------------|--------------|--------|-----------|-------------|-------------|-----------|
| number⊨ ¥ | 5 | 7 | 9 | 11 | M | 5 | 7 | 9 | 11 |
| 5.90 | 47.32378 | 55,30876 | 61.74262 | 67.46407 | 8,20 | 209.78426 | 235.00261 | 251.64339 | 264.93512 |
| 5.84 | 48.53361 | 56.68046 | 63.22366 | 69,03169 | 8.24 | 213.77943 | 240.50857 | 257.60321 | 270.75058 |
| 5.68 | 49.77478 | 58.08678 | 64.74106 | 70.63679 | 8.28 | 218.88353 | 246.13278 | 263.48439 | 276,78834 |
| 5.92 | 51.04807 | 59.52860 | 66.29572 | 72.28027 | 8.32 | 224.09872 | 251.87757 | 269.48930 | 282.95075 |
| 5.96 | 52.35416 | 61,00664 | 67.88837 | 73.95287 | 8.00 | 229.42711 | 201.14020 | 213.02018 | 205424000 |
| | FT 40407 | 60 50100 | 60 51004 | 75.68553 | 8.40 | 234.87055 | 263.73766 | 281.87910 | 295.65829 |
| 6.04 | 55.06800 | 64.07494 | 71.19132 | 77.44912 | 8.44 | 240.43144 | 269.85755 | 288.26865 | 302.20803 |
| 6.08 | 56.47732 | 65.66688 | 72.90336 | 79.25450 | 8,48 | 246.11189 | 276.10711 | 294.79111 | 308.89150 |
| 6.12 | 57.92256 | 67.29841 | 74.65684 | 61.10249 | 8.52 | 251.91407 | 282.48869 | , 301.44884 | 315.71107 |
| 6.16 | 59.40461 | 68.97051 | 76.45278 | 82.99409 | 8.56 | 257.84028 | 289.00476 | 308.24435 | 322.00921 |
| | AC | 70 60400 | 78 00011 | 84.93025 | 8,60 | 263.89278 | 295.65770 | 315.16005 | 329.76832 |
| 6.20 | 60.92931 | 72 44005 | 80.17577 | 86,91190 | 8.64 | 270.07382 | 302.45000 | 322.25841 | 337.01086 |
| 6 29 | 64.08009 | 74.23935 | 82.10472 | 88.94001 | 8.68 | 276.38579 | 309.35419 | 329.48201 | 344.39939 |
| 6.32 | 65.71800 | 76.08305 | 84.08006 | 91.01569 | 8.72 | 282.03099 | 316.46274 | 336.85336 | 351.93637 |
| 6.36 | 67.39708 | 77.97201 | 86.10266 | 93.13981 | 8.76 | 289.41178 | 323,68521 | 344.37502 | 359.62431 |
| | | | | 05 31330 | 0.00 | 906 13063 | 331 06325 | 352.04964 | 367-46587 |
| 6.40 | 69.11821 | 79.90720 | 88,17351 | 95.31337 | 0.04 | 290.13003 | 338.59058 | 359.87999 | 375.46379 |
| 6.44 | 70.88233 | 87.888802 | 90.29307 | 97.00742 | 9,88 | 309,99264 | 346.27287 | 367.86876 | 383.62074 |
| 0.40 | 72.09000 | 86.00065 | 94.68632 | 103.14145 | 8.92 | 317.14069 | 354.11274 | 376.01859 | 391.93930 |
| 6.56 | 76.44264 | 88.13129 | 96.96095 | 104.52357 | 8.96 | 324.43725 | 362.11339 | 364.33271 | 400.42271 |
| | | | | | | | | | 100 07776 |
| 6.60 | 78,28869 | 80.31349 | 99.28929 | 106.96059 | 9.00 | 331.88463 | 370.27728 | 392.81361 | 409.07000 |
| 6.64 | 80.38267 | 92.54826 | 101.67236 | 109.45355 | 9.04 | 339.48540 | 378.60720 | 401.40408 | 426.88811 |
| 6.6B | 82.42568 | 94.83681 | 104.11138 | 112.00368 | 9.08 | 341.24200 | 305.77751 | 419.28617 | 436.05794 |
| 6.72 | 84.51879 | 97,18029 | 106.60755 | 117.28003 | 9.16 | 363.23607 | 404.62346 | 428,46343 | 445.40668 |
| 0.10 | 80.00230 | 99.07975 | 100.10100 | 11 | | | | | i |
| 6.80 | 88,85945 | 102.03549 | 111.77583 | 120.00866 | 9.20 | 371.47841 | 413.64768 | 437.82263 | 454.93767 |
| 6.84 | 91.10931 | 104.55171 | 114.45048 | 122.79925 | 9.24 | 379.88791 | 422.85273 | 447.36631 | 464.65345 |
| 6.88 | 93.41368 | 107.12663 | 117,18712 | 125.65305 | 9.28 | 388,46795 | 432.24225 | 457.09813 | 4/4.00/09 |
| 6.92 | 95.77374 | 109.76249 | 119.98702 | 128.57133 | 9.52 | JU1.22099 | 451 58625 | 477.13781 | 494.94262 |
| 6.96 | 98,19076 | 112.46068 | 122.85161 | 191.90991 | 9.00 | 400+100+1 | 1 | | |
| 7 00 | 100 66501 | 115 00035 | 125,78205 | 134.60674 | 9.40 | 415.25917 | 461.54758 | 487.45260 | 505,43031 |
| 7.00 | 103.20013 | 118.04684 | 126.77971 | 137.72641 | 9.44 | 424.54994 | 471.70573 | 497.96794 | 516.11064 |
| 7.08 | 105.79496 | 120.94147 | 131.84592 | 140.91565 | 9.48 | 434.02638 | 482.06458 | 508.68776 | 527.01151 |
| 7.12 | 108.45164 | 123.90171 | 134.98218 | 144.17655 | 9.52 | 443.69093 | 492.62678 | 519.61476 | 538.11156 |
| 7.16 | 111.17135 | 126.93081 | 138.18977 | 147.50978 | 9.56 | 453.54722 | 503.39626 | 530.75287 | 349.45501 |
| | | 1 | 1 47 47 01 0 | 160 01605 | 0 60 | 463 59864 | 514.37666 | 542.10574 | 560.94846 |
| 7.20 | 113.95539 | 133 20136 | 141.47010 | 154 30967 | 9.64 | 473.84843 | 525.57149 | 553.67689 | 572,69246 |
| 7 24 | 119.72201 | 136-44568 | 148.25511 | 157.95924 | 9.68 | 484.29949 | 536.98379 | 565.46936 | 584.65760 |
| 7.32 | 122.70731 | 139.76478 | 151.76277 | 161.59732 | 9.72 | 494.95539 | 548.61744 | 577.48716 | 596.84779 |
| 7.36 | 125.76250 | 143.16011 | 155.34925 | 165.31542 | 9.76 | 505.81954 | 560.47616 | 589.73391 | 609-26667 |
| | | | | 100 11400 | 0.00 | 51C 00550 | 572 56393 | 602.21356 | 621.91816 |
| 7.40 | 126.88881 | 146.63302 | 159.01592 | 109.11489 | 0.04 | 528,18699 | 584.88412 | 614.92980 | 634.80563 |
| 7.44 | 132.08787 | 153,618500 | 166.59690 | 176.96489 | 9.88 | 539.69724 | 597.44086 | 627.88645 | 647.93350 |
| 7.52 | 138.71012 | 157.53415 | 170.51417 | 181.01858 | 9.92 | 551.43001 | 610.23792 | 641.08744 | 661.30498 |
| 7.56 | 142.13605 | 161.33369 | 174.51809 | 195.15999 | 9.96 | 563.38885 | 623.27916 | 654.53663 | 674.92411 |
| | | 1 | | | | | | 660 03703 | 800 70475 |
| 7.60 | 145.64072 | 165.21900 | 178.61052 | 189.39105 | 10.00 | 575.57744 | 640.56845 | 008.23/91 | 000.19410 |
| 7.64 | 149.22567 | 169.19177 | 182.79314 | 195.71346 | | 1 | | | |
| 7.68 | 152.89249 | 173.25367 | 101.43500 | 202,63015 | | | ł | | |
| 7.76 | 160.47819 | 181.65188 | 195.89954 | 207.24595 | | ł | | 1 | |
| | 100000000 | | | | 1 | | | 1 | 1 |
| 7.80 | 164.40038 | 185.99175 | 200.46047 | 211.95115 | | | | | 1 |
| 7.84 | 168.41107 | 190.42791 | 205.12056 | 216.75660 | | | 1 | | 1 |
| 7.8B | 172.51213 | 194.96233 | 209.38181 | 221.66431 | | | | 1 | 1 |
| 7.92 | 176,70506 | 192.59666 | 214.74590 | 231.79338 | r | 1 | 1 | 1 | |
| 7.96 | TGO*SATAT | , 201.20208 | 213.11410 | 1 | 3 | 1 | ! | 1 | |
| 8-00 | 185.37408 | 209,17316 | 224.79067 | 237.01692 | 3 | l | 1 | 1 | 1 |
| 8.04 | 189.85392 | 214.11938 | 229.97550 | 242.35443 | t: | 1 | | | 1 |
| 9.08 | 194.43292 | 219.17336 | 235.27107 | 247.80172 | | 1 | | | 1 |
| 8.12 | 199.11295 | 224.33709 | 240.67943 | 253.36279 | r F | | | | 1 |
| 0 10 | 203.20616 | · 229.61290 | 246.20292 | 1 \$23.02338 | li i | 1 | 1 | 1 | 1 |

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TABLE V - VARIATION OF MOMENTUM-THICKNESS RATIO f with mach number M and Velocity-PROFILE PARAMETER N

| f = - | 9 5 |
|-------|---------------|
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(a) Subsonic flow.

| Mach | Veloci | Velocity-profile parameter, N | | | | | | | | |
|-------|---------|-------------------------------|---------|---------|--|--|--|--|--|--|
| M | 5 | 7 | 9 | 11 | | | | | | |
| 0.100 | 0.11894 | 0.09715 | 0.08176 | 0.07048 | | | | | | |
| .200 | .11865 | .09695 | .08162 | .07037 | | | | | | |
| .300 | .11816 | .09662 | .08138 | .07019 | | | | | | |
| .400 | .11748 | .09616 | .08105 | .06994 | | | | | | |
| .500 | .11663 | .09557 | .08063 | .06962 | | | | | | |
| .600 | .11560 | .09487 | .08012 | .06924 | | | | | | |
| .700 | .11442 | .09406 | .07953 | .06879 | | | | | | |
| .800 | .11309 | .09315 | .07887 | .06829 | | | | | | |
| .900 | .11162 | .09214 | .07813 | .06772 | | | | | | |
| 1.000 | .11004 | .09104 | .07733 | .06711 | | | | | | |
| | | | | NACA | | | | | | |

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TABLE V - VARIATION OF MOMENTUM -THICKNESS RATIO f WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued

 $\left[\mathbf{r}=\frac{\mathbf{\theta}}{5}\right]$

| | r | | | | Wash | | | | |
|----------------|---------|-----------|-----------|---------|--------|---------|-----------|-----------|-----------|
| Mach number | Veloci | ty-profil | e paramet | er, N | number | Veloci | ty-profil | e paramet | er, N |
| X | 5 | 7 | 9 | 11 | M | 5 | 7 | 9 | 11 |
| 1.00 | 0.11004 | 0.09104 | 0.07733 | 0.06711 | 3.40 | 0.06441 | 0.05708 | -05066 | .04582 |
| 1.04 | .10938 | .09058 | .07654 | .06658 | 3.48 | .06314 | .05607 | .05024 | .04548 |
| 1.12 | 10801 | .08962 | .07628 | .06631 | 3.52 | .06251 | .05557 | .04984 | .04514 |
| 1.16 | .10730 | .08912 | .07592 | .06603 | 3.56 | .06189 | .05507 | •04943 | .04480 |
| 1.20 | .10658 | .08862 | .07555 | .06574 | 3.60 | .06128 | .05458 | .04903 | .04447 |
| 1.24 | .10585 | .08810 | .07516 | .06545 | 3.64 | .06067 | .05410 | .04863 | .04413 |
| 1.28 | .10511 | .08758 | .07478 | .06515 | 3.68 | .06007 | .05361 | .04823 | .04380 |
| 1.32 | .10435 | .08704 | .07438 | .06485 | 3.76 | .05889 | .05266 | .04745 | .04314 |
| 1+00 | .10339 | .00000 | •07000 | .00101 | 0 | | | | |
| 1.40 | .10281 | .08595 | .07357 | .06422 | 3.80 | .05832 | .05219 | .04706 | .04282 |
| 1.44 | .10203 | .08540 | .07315 | .06390 | 3.28 | .05718 | .05127 | .04630 | 04217 |
| 1.52 | .10045 | 08427 | .07231 | .06324 | 3.92 | .05662 | .05082 | .04592 | .04186 |
| 1.56 | .09965 | .08369 | .07188 | .06291 | 3.96 | •05606 | .05037 | •04555 | .04154 |
| 1 60 | 00004 | 08311 | .07144 | .06257 | 4.00 | .05551 | .04992 | .04518 | .04123 |
| 1.64 | .09803 | .08253 | .07100 | .06223 | 4.04 | .05497 | .04948 | .04481 | .04092 |
| 1.68 | .09721 | .08194 | .07056 | .06188 | 4.08 | .05444 | .04904 | .04445 | .04061 |
| 1.72 | .09640 | .08135 | .07011 | .06153 | 4.12 | .05391 | .04861 | .04409 | .04030 |
| 1,76 | .09557 | •08075 | *roa00 | *00TT0 | 4010 | •00009 | | 101010 | |
| 1.80 | .09475 | .08016 | .06921 | .06083 | 4.20 | .05287 | .04775 | .04337 | .03969 |
| 1.84 | .09393 | .07956 | .06875 | .06047 | 4.24 | .05236 | .04733 | .04302 | .03939 |
| 1.88 | .09310 | .07895 | .06784 | .05974 | 4.32 | .05136 | .04651 | .04233 | .03880 |
| 1.96 | .09145 | .07774 | .06737 | .05938 | 4.36 | .05087 | .04610 | .04198 | .03851 |
| 0.00 | 00007 | 000034 | 06603 | 05001 | 4 40 | 05038 | .04570 | .04164 | .03822 |
| 2.00 | .09063 | .07653 | .06644 | .05864 | 4.44 | .04990 | .04530 | .04131 | .03793 |
| 2.08 | .08898 | .07592 | .06598 | .05827 | 4.48 | .04942 | .04490 | .04098 | .03765 |
| 2.12 | .08816 | .07532 | .06551 | .05790 | 4.52 | •04895 | .04451 | .04065 | .03736 |
| 2,16 | .08734 | +07471 | .06504 | .05755 | 4.00 | .04649 | .04412 | .09002 | .00708 |
| 2.20 | .08653 | .07410 | .06457 | .05716 | 4.60 | .04803 | .04374 | .03999 | .03680 |
| 2.24 | .08572 | .07350 | .06410 | .05678 | 4.64 | •04758 | •04336 | .03967 | 03605 |
| 2.28 | .08491 | .07289 | .06317 | .05603 | 4.72 | .04669 | .04262 | .03904 | .03598 |
| 2.36 | .08330 | .07168 | .06270 | .05566 | 4.76 | .04625 | .04225 | .03873 | .03571 |
| | 00050 | 077.00 | 00007 | 05500 | 4 00 | 04582 | .04199 | .03842 | .03545 |
| 2.40 | .08250 | .07108 | .06225 | .05528 | 4.84 | .04539 | .04153 | .03811 | .03518 |
| 2.48 | .08092 | .06989 | .06130 | .05453 | 4.88 | .04497 | .04117 | .03781 | .03492 |
| 2.52 | .08014 | .06930 | .06083 | .05416 | 4.92 | .04455 | .04082 | .03751 | .03466 |
| 2.56 | .07936 | .06870 | .06037 | .05378 | 4.90 | .04414 | .04047 | .03721 | .00110 |
| 2.60 | .07859 | .06812 | .05990 | .05341 | 5.00 | .04373 | .04013 | .03692 | .03415 |
| 2.64 | .07782 | .06753 | .05944 | .05304 | 5.04 | .04333 | .03979 | .03663 | .03389 |
| 2.68 | .07706 | .06695 | .05898 | .05266 | 5.12 | .04293 | .03945 | .03605 | .03339 |
| 2.76 | .07555 | .06579 | .05807 | .05192 | 5.16 | .04215 | .03879 | .03577 | .03315 |
| 0.00 | 07400 | 04500 | 05763 | 05155 | 5 00 | 041777 | 03946 | 03540 | .03290 |
| 2.84 | .07480 | .06522 | .05716 | .05118 | 5.24 | .04139 | .03814 | .03521 | .03266 |
| 2.88 | .07333 | .06408 | .05671 | .05081 | 5.28 | .04102 | .03782 | .03493 | .03242 |
| 2.92 | .07261 | .06352 | .05626 | .05044 | 5.32 | .04065 | .03751 | .03466 | .03218 |
| 2.96 | .07189 | .06236 | .05581 | .05008 | 5.35 | .04028 | .03/18 | .03439 | .03194 |
| 3.00 | .07117 | .06240 | .05537 | .04972 | 5.40 | .03992 | .03688 | .03412 | .03171 |
| 3.04 | .07047 | .06185 | .05493 | .04935 | 5.44 | .03956 | .03658 | .03386 | .03148 |
| 3.12 | .06977 | .06131 | .05405 | .04899 | 5.52 | .03886 | .03598 | .03334 | .03102 |
| 3.16 | .06839 | .06022 | .05362 | .04828 | 5.56 | .03852 | .03568 | .03308 | .03079 |
| | 00000 | 05000 | 05710 | 04700 | 5 60 | 07010 | 07570 | 03000 | 01057 |
| 3.24 | .06703 | .05969 | .05276 | .04757 | 5.64 | .03784 | .03510 | .03257 | .03035 |
| 3.28 | 06F 37 | .05863 | .05233 | .04721 | 5.68 | .03751 | .03481 | .03232 | .03013 |
| 3.32 | .06571 | .05811 | .05191 | .04686 | 5.72 | .03718 | .03453 | .03207 | .02091 |
| 3.36 | ,06505 | 05759 | .05149 | 04651 | 5.76 | 1_03656 | .03425 | 103183 | 1. 102970 |
| | | | | | | | | ~_ N/ | ACA |

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(b) Supersonic flow.

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TABLE V - VARIATION OF MOMENTUM -INICKNESS RATIO f WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Concluded

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$\begin{bmatrix} \mathbf{f} = \frac{\mathbf{\theta}}{\mathbf{\delta}} \end{bmatrix}$

(b) Supersonic flow - Concluded.

| Mach | Veloc | Velocity-profile parameter, N | | | | Velocity-profile parameter, M | | | |
|----------|---------|-------------------------------|---------|----------|---------|-------------------------------|---------|---------|---------|
| mumber | | | 0 | 11 | W | 5 | 7 | 9 | 11 |
| <u> </u> | 5 | | 0 07150 | 0.00049 | 8.20 | 0.02264 | 0.02164 | 0.02060 | 0.01961 |
| 5.80 | 0.03653 | 0.03397 | 0.03135 | 02027 | 8.24 | .02248 | .02149 | .02046 | .0194B |
| 5.84 | .03622 | .03369 | .03135 | 02906 | 8.29 | .02232 | .02134 | .02033 | .01936 |
| 5.88 | .03590 | .03342 | .03111 | 02995 | 8.32 | .02216 | .02120 | .02019 | .01924 |
| 5.92 | .03559 | .03315 | .03087 | 02000 | 8.36 | .02200 | .02105 | .02006 | .01912 |
| 5.96 | .03529 | .03289 | .03064 | .02000 | 0.00 | | | | |
| | | | 07047 | 02044 | 9.40 | .02184 | .02091 | .01993 | .01900 |
| 6.00 | .03499 | .03262 | .03041 | 00004 | 0.10 | .02168 | .02077 | .01980 | .01888 |
| 8.04 | .03469 | .03236 | .03016 | 02004 | 9.49 | .02153 | .02063 | .01967 | .01876 |
| 6.08 | .03439 | .03210 | 02995 | 02704 | 8.52 | .02138 | .02049 | .01954 | .01865 |
| 6.12 | .03410 | .03185 | .02973 | 00764 | 8.56 | .02123 | .02035 | 01942 | .01853 |
| 6.16 | .03381 | .03160 | .02951 | .02/04 | 0.00 | | | | |
| | | 003.85 | 00000 | 00745 | 9.60 | 80150. | .02021 | .01929 | .01841 |
| 6.20 | .03352 | .03135 | .02929 | 02725 | 8.64 | .02093 | .02008 | .01917 | .01830 |
| 6.24 | .03324 | .03110 | .02907 | 02706 | 83.8 | 02078 | .01994 | .01905 | .01819 |
| 6.28 | .03296 | .03086 | .02865 | 02697 | 8.72 | 02064 | .01981 | .01892 | .01808 |
| 6.32 | .03269 | .03061 | 02004 | 02668 | 8.76 | .02050 | .01968 | .01880 | .01796 |
| 6.36 | .03241 | .03037 | +02045 | .02000 | 0.10 | | | | 1 |
| 1 | | 07034 | 00000 | 02440 | 8.90 | .02035 | .01955 | .01868 | .01785 |
| 6.40 | .03214 | .03014 | .02822 | 02013 | 9.94 | 02021 | 01942 | .01857 | .01774 |
| 6.44 | .03188 | .02990 | .02801 | 02601 | 8.89 | 02007 | .01929 | .01845 | .01764 |
| 6.48 | .03161 | 02967 | 00760 | 02504 | 8.92 | 01994 | .01916 | .01833 | .01753 |
| 6.52 | .03135 | .02944 | 02700 | 02574 | 8.96 | 01980 | .01904 | .01822 | .01742 |
| 6.56 | .03110 | . OZAST | .02740 | | 0.00 | | | | |
| | 1 | 00000 | 00700 | 02550 | 9.00 | .01956 | .01891 | .01810 | .01732 |
| 6.60 | .03084 | .02899 | .02720 | 02500 | 9.04 | .01953 | 01879 | .01799 | .01721 |
| 6.64 | .03059 | .02877 | .02700 | 02541 | 0.09 | 01940 | 01867 | .01788 | .01711 |
| 6.68 | .03034 | .02855 | .02681 | 02525 | 0 12 | 01927 | .01855 | .01776 | .01701 |
| 6.72 | .03009 | .02855 | .02001 | .02000 | 0 16 | 01014 | .01843 | .01765 | .01690 |
| 6.76 | .02985 | .02811 | .02042 | .04409 | 1 9.10 | | | 1 | |
| 1 | | 00700 | 00007 | 02472 | 0.20 | .01901 | .01831 | .01754 | .01680 |
| 6.80 | .02961 | .02790 | .02623 | 00455 | 0 24 | 01888 | .01819 | .01744 | .01670 |
| 6.84 | .02937 | .02769 | .02604 | 02400 | 0.00 | 01975 | 01807 | 01733 | .01660 |
| 6.88 | .02914 | .02748 | .02586 | .02438 | 9.20 | 01963 | 01796 | 01722 | .01650 |
| 6.92 | .02890 | .02727 | .02567 | .02421 | 9.52 | 01950 | 01784 | .01711 | .01641 |
| 6.96 | .02867 | .02707 | .02549 | .02405 | 9.00 | .01000 | | | |
| | | | 00573 | 00300 | 0 40 | 01838 | .01773 | .01701 | .01631 |
| 7.00 | .02844 | .02686 | .02531 | 02303 | 9.40 | 01826 | 01762 | .01691 | .01621 |
| 7.04 | .02822 | .02666 | .02515 | .02072 | 0 40 | 01914 | 01750 | 01680 | .01612 |
| 7,08 | .02800 | .02646 | .02495 | 02341 | 0 52 | .01802 | .01739 | .01670 | .01602 |
| 7.12 | .02778 | .02627 | .02478 | 02341 | 0.56 | 01700 | 01728 | .01660 | .01593 |
| 7.16 | .02756 | .02607 | .02460 | +02020 | 8.00 | .01.30 | | | 1 |
| | | 00500 | 00447 | 00300 | 0 60 | .01778 | .01717 | .01650 | .01583 |
| 7.20 | .02734 | .02588 | .02443 | .02309 | 9.00 | 01767 | .01707 | 01640 | .01574 |
| 7.24 | .02713 | .02569 | .02420 | 000079 | 0.69 | .01755 | 01696 | .01630 | .01565 |
| 7.28 | .02692 | .02550 | .02409 | .02210 | 0 70 | 01744 | .01685 | 01620 | .01550 |
| 7.32 | .02671 | .02531 | 02392 | 02205 | 9.76 | .01733 | 01675 | .01610 | .0154' |
| 7.36 | .02650 | .02513 | .02375 | | 1 | 1.02.00 | | | |
| 1 | 00000 | 02405 | 02350 | 02233 | 9,90 | .01721 | .01665 | .01601 | .01536 |
| 7.40 | .02030 | .02490 | .02343 | .02219 | 9.84 | 01710 | .01654 | .01591 | . 0152 |
| 1 | .02010 | 02450 | 02326 | 02204 | 9.88 | .01699 | .01644 | .01582 | .01520 |
| 1 7.48 | .02390 | 00441 | 02310 | 02190 | 9.92 | .01689 | .01634 | .01572 | .0151 |
| 7.52 | 02570 | 00491 | 02010 | 02175 | 9.96 | .01678 | .01624 | .01563 | .0150 |
| 7.50 | | | | 1 | 1 | 1 | | | 1 |
| 1 7 60 | 02531 | 02406 | .02279 | 02161 | 1 10.00 | .01667 | .01614 | .01554 | .0149 |
| 1 7.60 | 02001 | 00200 | 02263 | .02146 | 11 | 1 | | 1 | |
| 7.04 | .02312 | 00030 | 00010 | .02130 | | 1 | | 1 | |
| 7.00 | 02493 | 02354 | .02232 | .02110 | 1 | 1 | | | |
| 1.72 | 00454 | 02330 | .02217 | 02105 | 1 | 1 | | 1 | |
| 7.76 | | | | | 1 | | | | |
| | 00410 | 1 09391 | .02202 | 1,02091 | | | | | |
| 7.80 | .02437 | 02305 | .02107 | 02079 | 1 | l | 1 | | 1 |
| 7.84 | 02419 | 02000 | .02173 | .02064 | 1 | 1 | 1 | | |
| 7.88 | 002401 | 02200 | 02159 | .02051 | | | | 1 | 1 |
| 7.92 | .02384 | 00054 | 02100 | 02039 | | 1 | 1 | 1 | |
| 1.486 | .02360 | | | | 1 | 1 | | | |
| | 00340 | 1.00041 | .02120 | .02025 | 1 | | | | 1 |
| 8.00 | 02045 | 00005 | 02115 | 02012 | H | | 1 | | |
| 1 8.04 | | .02220 | .09101 | .01999 | | | 1 | 1 | 1 |
| 8.00 | 02019 | 1 00104 | 02007 | 101986 | | 1 | | | |
| 0.12 | .0229 | 02170 | .02077 | .01973 | 1 | | | | |
| 8.10 | .0228. | | 1.02010 | 1 941910 | - # | _ I | | | ~~~~ |

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TABLE VI - VARIATION OF DISPLACEMENT-THICKNESSRATIOgWITHMACHNUMBERMVELOCITY-PROFILEPARAMETERN

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$$\left[g = \frac{\delta^*}{\delta}\right]$$

ALINE

(a) Subsonic flow.

| Mach | Veloci | lty-profil | e paramet | er, N |
|-------|---------|------------|-----------|---------|
| M | 5 | 7 | 9 | 11 |
| 0.100 | 0.16708 | 0.12533 | 0.10026 | 0.08353 |
| .200 | .16832 | .126375 | .1011.5 | .08431 |
| .300 | .17038 | .12811 | .10264 | .08561 |
| .400 | .17324 | .13052 | .10471 | .08742 |
| •500 | .17687 | .13359 | .10735 | .08973 |
| .600 | .18124 | .13728 | .11054 | .09253 |
| .700 | .18631 | .14159 | .11426 | .09579 |
| •800 | .19204 | .14647 | .11848 | .09951 |
| •900 | .19838 | .15189 | .12319 | .10366 |
| 1.000 | .20530 | .15782 | .12836 | .10822 |
| | | | | NACA |

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TABLE VI - VARIATION OF DISPLACEMENT-THICKNESS RATIO g WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued

$\left[g = \frac{\delta^{\#}}{\delta}\right]$

(b) Supersonic flow.

| Mach | V-1 | | | | Mach | Veloci | tw_profil | e navamet | er. W |
|----------|-------------------------|------------|-----------------|--------|----------|-----------|-----------|-----------|----------|
| number | Veloci | cy-profile | e paramet | er, N | number | 701001 | | e paramet | 17 |
| <u>N</u> | 0 | 7 | 9 | 11 | <u>m</u> | 0 43030 | 0 36603 | 0 31894 | 0.28336 |
| 1.00 | 0.20530 | 16033 | 13054 | 11016 | 3.44 | 43595 | .36958 | 32234 | 28660 |
| 1.08 | .21120 | .16291 | 13280 | .11215 | 3.48 | 43958 | .37312 | .32573 | .28982 |
| 1.12 | .21426 | 16556 | 13512 | .11421 | 3.52 | .44319 | .37664 | .32911 | .29305 |
| 1.16 | 21740 | 16828 | .13750 | .11632 | 3.56 | .44677 | .38015 | .33248 | .29626 |
| | | | | | | | | | |
| 1.20 | .22061 | .17106 | .13994 | .11849 | 3.60 | .45033 | .38364 | •33583 | .29947 |
| 1.24 | .22389 | .17391 | .14244 | .12072 | 3.64 | .45387 | .38711 | .33918 | .30267 |
| 1.28 | 22722 | .17681 | .14500 | .12299 | 3.68 | •45738 | .39056 | .34251 | •30586 |
| 1.32 | •23062 | .17978 | .14761 | .12532 | 3.72 | •46088 | .39400 | •34583 | .30904 |
| 1,36 | .23408 | •19280 | 1 5028 | .12770 | 3.76 | .46434 | .39742 | •34914 | • 31221 |
| | | | 3.5000 | 32017 | 7 00 | 4 6 77 70 | 40000 | 35043 | 31530 |
| 1.40 | .23759 | .18587 | 10299 | 13061 | 3.00 | 47101 | 40421 | -35571 | .31853 |
| 1.44 | •24115 | •13900 | 150570 | 13513 | 3.88 | .47460 | 40757 | -35898 | .32168 |
| 1 50 | 24913 | 10530 | .16143 | .13769 | 3.92 | 47797 | 41092 | .36223 | .32481 |
| 1 56 | -25210 | 19866 | .16434 | .14030 | 3.96 | 48132 | .41425 | .36547 | .32794 |
| 1.00 | | | •••••• | ••••• | | | • | | |
| 1.60 | .25584 | .20196 | .16728 | .14294 | 4.00 | .49464 | .41756 | .36870 | .33105 |
| 1.64 | .25961 | .20531 | .17027 | .14563 | 4.04 | .48794 | .42085 | .37191 | .33415 |
| 1.68 | .26341 | .20869 | .17329 | .14835 | 4.08 | .49121 | .42412 | .37510 | .33725 |
| 1.72 | .26725 | .21211 | .17635 | .15111 | 4.12 | .49446 | .42737 | .37828 | .34033 |
| 1.76 | .27112 | .21557 | .17944 | .15391 | 4.16 | .49769 | .43060 | .38145 | .34339 |
| | | | | | | 60000 | 40000 | | 1 11000 |
| 1.80 | .27501 | .21905 | .18257 | .15674 | 4.20 | .50089 | .43381 | •36460 | .34645 |
| 1.84 | •27892 | .22256 | .18573 | .15960 | 4.24 | .50407 | .43701 | .38773 | .34930 |
| 1.88 | .28286 | .22610 | 10013 | 10249 | 4.20 | -50722 | 144010 | .30305 | -35555 |
| 1.92 | .28682 | .22907 | 10537 | 16036 | 4.02 | 51345 | 44004 | 39704 | 35855 |
| 1.90 | •29079 | .20020 | .15007 | .10000 | 1 | .01010 | 111011 | | |
| 2.00 | .29478 | .23686 | .19864 | .17133 | 4.40 | .51654 | .44958 | .40011 | .36155 |
| 2.04 | 29878 | 24049 | 20193 | .17433 | 4.44 | 51959 | 45268 | .40317 | .36453 |
| 2.08 | 30280 | .24414 | 20524 | .17735 | 4.48 | .52263 | .45575 | .40620 | .36750 |
| 2.12 | .30682 | .24780 | .20858 | .18040 | 4.52 | .52564 | .45881 | .40923 | .37045 |
| 2.16 | .31085 | .25148 | .21193 | .18346 | 4.56 | .52862 | .46184 | .41223 | .37339 |
| | | | 1 | | | | | | |
| 2,20 | .31489 | .25517 | .21530 | .18655 | 4.60 | .53158 | .46496 | .41522 | .37632 |
| 2.24 | .31993 | .25888 | •21868 | .13965 | 4.64 | .53452 | •46786 | .41819 | .37923 |
| 2.28 | .32297 | .26259 | .22208 | .19278 | 4.68 | .53744 | .47083 | .42115 | .38214 |
| 2.32 | .32701 | .26631 | .32549 | .19592 | 4.72 | .54033 | .47379 | .42409 | .38502 |
| 2.36 | .33105 | •27004 | •55885 | .19907 | 4.76 | .54320 | •47672 | •42701 | .38790 |
| 0.00 | 77500 | 07770 | 07076 | 00004 | 1 100 | 54504 | 47064 | 40000 | 30075 |
| 2.40 | 433309 | 07750 | 03500 | 20542 | 4.50 | 54997 | 49253 | .43281 | 39360 |
| 2.49 | -34316 | .28126 | -23926 | 20861 | 4.98 | .55167 | 48541 | 43568 | 39643 |
| 2.52 | .34718 | 23501 | -24272 | .21192 | 4.92 | .55444 | 49827 | 43854 | 39925 |
| 2.56 | .35120 | 28875 | -24619 | .21503 | 4.96 | .55720 | .49110 | 44138 | 40205 |
| | | | | 1 | | | | | |
| 2.60 | .35521 | .29250 | .24966 | .21825 | 5.00 | .55993 | .49392 | .44420 | .40484 |
| 2.64 | .35921 | .29624 | .25314 | .22149 | 5.04 | .56264 | .49672 | .44701 | .40761 |
| 2.68 | .36320 | •58888 | .25662 | .22472 | 5.08 | .56533 | .49950 | .44979 | .41037 |
| 2.72 | •36718 | .30373 | .26011 | .22797 | 5.12 | .56800 | .50226 | .45257 | .41312 |
| 2.76 | .37114 | •30746 | .26359 | .23122 | 5,16 | .57064 | •50500 | •45532 | .41585 |
| 0.00 | 1000 | | 00000 | 07110 | 6 00 | E 777 07 | FORMA | 45000 | 1 1205- |
| 2.80 | .57509 | • 31119 | .26708 | .23448 | 5.20 | .57327 | .50772 | .45806 | 41856 |
| 2.64 | •37903 3050C | 31027 | -27006 07405 | 24100 | 5.00 | 57044 | .01042 | .400/8 | 42120 |
| 2.92 | -38686 | .32234 | 27753 | -24426 | 5.32 | .59100 | .51577 | 46618 | 42662 |
| 2.96 | .39075 | -32605 | 28101 | .24753 | 5.36 | .58354 | .51841 | 46885 | 42928 |
| | | 1 | | 101100 | | , | | 1 | |
| 3.00 | .39463 | .32974 | .28449 | .25079 | 5.40 | .58606 | .52104 | .47150 | .43193 |
| 3.04 | .39848 | .33342 | .28797 | .25406 | 5.44 | .58855 | .52364 | .47414 | .43455 |
| 3.08 | .40232 | .33709 | .29143 | .25733 | 5.48 | .59103 | .52623 | .47676 | .43717 |
| 3.12 | .40614 | .34076 | .29490 | .26059 | 5.52 | .59349 | .52880 | .47937 | .43977 |
| 3.16 | .40994 | .34441 | .29836 | .26385 | 5.56 | .59592 | •53135 | .48196 | .44235 |
| | | | | | | ł | | | |
| 3.20 | .41372 | •34804 | .30181 | .26711 | 5.60 | .59834 | •53388 | .49453 | .44493 |
| 3.24 | .41747 | .35167 | .30525 | .27037 | 5.64 | .60073 | .53640 | .48709 | .44748 |
| 3.28 | •42121 | .35528 | .30869 | ,27363 | 5.68 | .60310 | .53890 | .48963 | .45002 |
| 3.32 | •42493 | .35888 | .31211 | .27688 | 5.72 | .60546 | .54137 | .49215 | .45255 |
| 3.36 | •42863 | • 00246 | .31553 | •28015 | 5.76 | 1 00779 | .54383 | .49466 | 1 .45506 |
| | | | | | | | | N | ΔζΔ |

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TABLE VI - VARIATION OF DISPLACEMENT-THICKNESS RATIO g WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Concluded

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$\left[g = \frac{\delta^{*}}{\delta}\right]$

| (b |) | Supersoni | С | flow. | - | Concluded. |
|-----|---|-----------|---|-------|---|------------|
| • - | • | | | | - | |

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| Mach | Veloci | ty-profil | e paramet | er. N | Mach | Veloc | ty-profil | le paramet | er, N |
|------|---------|-----------------|----------------|-----------------|--------|-------------|-----------------|-----------------|---------|
| M | 5 | 7 | 9 | 11 | MUMBer | 5 | 7 | 9 | 11 |
| 5.30 | 0.61012 | 0.54628 | 0.49715 | 0.45756 | 8.20 | 0.71964 | 0.66442 | 0.62011 | 0.59297 |
| 5.84 | .61241 | .54870 | .49963 | .46005 | 8.24 | .72106 | .66598 | .62177 | •58469 |
| 5.88 | .61469 | .55111 | •50209 | .46252 | 8.29 | •72246 | .66754 | •62342 | •58640 |
| 5.92 | .61695 | .55350 | •50453 | .46497 | 8.32 | •72387 | •66908 | .62006 | • 58810 |
| 2.30 | •01313 | .00087 | •20636 | .40741 | 8.00 | .12020 | .07001 | •02003 | .003/3 |
| 6.00 | .62142 | .55823 | .50937 | .46984 | 8.40 | .72663 | .67213 | .62830 | .59146 |
| 6.04 | .62362 | ,56056 | .51177 | .47225 | 8.44 | .72800 | . 67364 | .62991 | .59313 |
| 6.08 | .62580 | .56288 | .51415 | .47465 | 8.49 | •72934 | .67514 | .63151 | •59479 |
| 6.12 | .62798 | .56519 | .51651 | .47704 | 8.52 | .73070 | •67663 | .63309 | +59644 |
| 6.18 | .63012 | .56748 | .51886 | •47941 | 8.00 | •73204 | .0/811 | .03400 | •19007 |
| 6.20 | .63226 | .56975 | .52120 | .48176 | 8.60 | .73337 | •6795 7 | .63623 | •59970 |
| 6.24 | .63437 | .57200 | .52352 | .48411 | 8.64 | •73468 | .68103 | .63778 | .60132 |
| 6.28 | .63647 | .57424 | .52582 | .48643 | 8.68 | •73598 | .68248 | .63932 | .60292 |
| 6.32 | .63856 | •57646 | .52811 | .48875 | 8.72 | .73729 | +08391 60534 | +04080 64030 | .60432 |
| 8,00 | .04002 | •37500 | .00000 | •49103 | 0.10 | . 10001 | .00004 | .01.00 | |
| 6.40 | .64267 | .58085 | .53264 | .49334 | 8,80 | •73985 | .68676 | .64389 | .60768 |
| 6.44 | .64469 | .58302 | .53488 | .49561 | 8.94 | .74112 | .68816 | .64540 | .60925 |
| 6.48 | .64670 | .58518 | .53711 | .49787 | 8.98 | .74236 | •68956 | •64689 | .61081 |
| 6.52 | .64871 | .58732 | -53933 | .50011 | 8.92 | .74363 | .609095 | .64095 | .01236 |
| 0.00 | .03009 | .00944 | *04T95 | .00200 | 0.90 | + · # # 0 0 | .03606 | .01300 | |
| 6.60 | .65266 | .59155 | .54371 | .50457 | 9.00 | .74610 | .69369 | .65131 | .61542 |
| 6.64 | .65460 | •59365 | . 54588 | .50677 | 9.04 | .74732 | .69505 | .65277 | .61694 |
| 6.68 | .65653 | .59572 | .54803 | .50896 | 9.08 | .74852 | .69640 | .65421 | .61345 |
| 6.72 | .65845 | •59779 | •22018 | .51114 | 9.12 | .74973 | .69774 | 65707 | 62144 |
| 0.10 | .00000 | .39965 | .00200 | .01001 | 3.10 | .10032 | .03301 | | |
| 6.80 | .66224 | .60187 | •55442 | .51546 | 9.20 | .75212 | .70039 | .65849 | .62292 |
| 6.84 | .66411 | .60389 | .55651 | .51760 | 9.24 | •75329 | .70170 | .65990 | .62440 |
| 6.88 | .66596 | .60589 | .55860 | .51972 | 9.28 | .75445 | .70300 | .56130 | .62386 |
| 6.92 | .66781 | .60788 | .56273 | .52394 | 9.36 | .75678 | .70430 | .66406 | .62876 |
| 0.00 | •00500 | | | | | | •••••• | | |
| 7.00 | .67145 | .61181 | .56477 | .52602 | 9.40 | .75794 | .70686 | .66544 | .63020 |
| 7.04 | .67325 | .61376 | .56680 | .52810 | 9.44 | .75907 | .70812 | .66680 | .63163 |
| 7.08 | .67502 | .61369 | .36662 | 530010 | 9.40 | 76133 | .71063 | .66950 | .63445 |
| 7.16 | .67855 | .61951 | 57281 | .53424 | 9.56 | .76243 | .71187 | .67083 | .63586 |
| | | | | | | | | | |
| 7.20 | .68029 | .62140 | .57478 | .53627 | 9.60 | .76354 | .71311 | .67216 | .63725 |
| 7.24 | .08201 | •02027 62513 | .57675 | -53828 54028 | 9.04 | 76570 | .71555 | .67479 | .64001 |
| 7.32 | 68543 | 62698 | .58063 | .54226 | 9.72 | 76681 | .71675 | .67609 | .64138 |
| 7.36 | .68711 | .62882 | .58256 | .54424 | 9.76 | .76788 | .71795 | .67738 | .64274 |
| | 000000 | 67004 | 50447 | 54000 | 0.00 | 76005 | 71014 | 67067 | 64400 |
| 7.40 | •08879 | .03064 | .58636 | -54815 | 9.50 | .77001 | .72033 | .67995 | .64543 |
| 7.48 | -69209 | 63424 | .58825 | .55008 | 9.58 | .77105 | .72130 | .68122 | .64676 |
| 7.52 | .69374 | .63602 | .59012 | .55201 | 9.92 | .77211 | .72267 | .68248 | .64809 |
| 7.56 | .69535 | .63779 | .59198 | .55392 | 9.96 | .77314 | .72383 | .68373 | .64941 |
| 7 60 | enene | 67055 | 50303 | 55500 | 120.00 | 77410 | 72409 | 69497 | 65072 |
| 7.64 | .69856 | .64129 | -59567 | .55771 | 10.00 | •//410 | 12430 | .00101 | |
| 7.68 | .70013 | 64302 | .59749 | 55959 | | | | | |
| 7.72 | .70171 | .64474 | .59930 | .56146 | | | | | |
| 7.76 | •70327 | .64645 | .60110 | •56331 | | | | | Į. |
| 7.90 | .70482 | 64914 | 60280 | .56516 | | | | | 1 |
| 7.84 | 70635 | 64982 | .60466 | .56699 | | | | | 1 |
| 7.88 | .70786 | .65149 | .60642 | .56881 | | | | | 1 |
| 7.92 | •70938 | . 65315 | .60818 | .57062 | | | | | 1 |
| 7.96 | •71088 | .65479 | .60991 | .57241 | | | | | |
| 8.00 | .71937 | 65643 | .61164 | .57420 | | | | | 1 |
| 8.04 | 71385 | .65805 | .61336 | .57598 | | | | | 1 |
| 8.08 | .71530 | .65966 | .61506 | .57774 | | | 1 | | 1 |
| 8.12 | •71676 | .66126 | .61676 | .57949 | | | | ł | 1 |
| 8,16 | •71820 | .66284 | .61844 | .58124 | Ш | | L | <u> </u> | 1 |

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TABLE VII - VARIATION OF SHAPE PARAMETER H WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N

$$\left[H = \frac{\delta^*}{\Theta}\right]$$

| | · | · · · · · · · · · · · · · · · · · · · | | | | | | |
|-------|-------------------------------|---------------------------------------|---------|---------|--|--|--|--|
| Mach | Velocity-profile parameter, N | | | | | | | |
| M | 5 | 7 | 9 | 11 | | | | |
| 0.100 | 1.40466 | 1.29006 | 1.22618 | 1.18509 | | | | |
| .200 | 1.41866 | 1.30353 | 1.23934 | 1.19808 | | | | |
| .300 | 1.44198 | 1.32596 | 1.26127 | 1.21969 | | | | |
| .400 | 1.47463 | 1.35737 | 1.29199 | 1.24993 | | | | |
| .500 | 1.51658 | 1.39773 | 1.33142 | 1.28885 | | | | |
| .600 | 1.56785 | 1.44704 | 1.37965 | 1.33629 | | | | |
| .700 | 1.62840 | 1.50531 | 1.43663 | 1.39251 | | | | |
| .800 | 1.69821 | 1.57249 | 1.50233 | 1.45715 | | | | |
| .900 | 1.77728 | 1.64860 | 1.57677 | 1.53071 | | | | |
| 1.000 | 1.86559 | 1.73364 | 1.65994 | 1.61262 | | | | |
| | | | | NACA | | | | |

(a) Subsonic flow.

TABLE VII - VARIATION OF SHAPE PARAMETER H WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Continued

$\left[H = \frac{\delta^{*}}{\Theta}\right]$

(b) Supersonic flow.

| Kach | Velocity-profile parameter, N | | | Mach | Veloci | ty_profi | le parameter, N | | |
|------|-------------------------------|--------|--------|--------|-------------|----------|-----------------|-----------|----------|
| X | 5 | 7 | 9 | 11 | nuncer M | 5 | 7 | 9 | 11 |
| 1.00 | 1.8656 | 1.7336 | 1.6599 | 1.6126 | 3.40 | 6.7118 | 6.4125 | 6.2452 | 6.1377 |
| 1.04 | 1.9035 | 1.7701 | 1.6956 | 1.6478 | 3.44 | 6.8364 | 6.5330 | 6.3634 | 6.2544 |
| 1.08 | 1.9429 | 1.3080 | 1.7327 | 1.6844 | 3.48 | 6.9524 | 6.6548 | 6.4930 | 6.3725 |
| 1.16 | 2.0261 | 1.9992 | 1.9111 | 1.7616 | 3.56 | 7.0398 | 6.0027 | 6.7261 | 6.6127 |
| 1.00 | 2.0201 | 1.0002 | TOTIT | 1.1010 | 0.00 | 1.2101 | 0.0021 | 0.1201 | 0.0121 |
| 1.20 | 2.0699 | 1.9303 | 1.9524 | 1.9023 | 3.60 | 7.3490 | 7.0287 | 6.8498 | 6.7348 |
| 1.24 | 2.1151 | 1.9739 | 1.8950 | 1.8444 | 3.54 | 7.4807 | 7.1560 | 6.9748 | 6.9583 |
| 1.28 | 2.1019 | 2.0190 | 1,9391 | 1,0326 | 3.68 | 7.0138 | 7.2948 | 7 2200 | 7 1000 |
| 1.36 | 2.2597 | 2.1132 | 2.0314 | 1.9788 | 3.76 | 7.8843 | 7.5465 | 7.3579 | 7.2367 |
| | | | | | | | | | |
| 1.40 | 2.3108 | 2.1625 | 2.0796 | 2.0263 | 3.90 | 8.0217 | 7.6794 | 7.4883 | 7.3656 |
| 1.44 | 2.3634 | 2.2132 | 2,1292 | 2.0752 | 3.84 | 8.1605 | 7.8137 | 7.6201 | 7.4957 |
| 1.52 | 2.4730 | 2.3198 | 2.2325 | 2.1771 | 3.92 | 8.4424 | 8.0864 | 7.9877 | 7,7602 |
| 1.56 | 2,5300 | 2.3737 | 2.2863 | 2.2301 | 3.96 | 8.5854 | 8.2248 | 8.0236 | 7.9944 |
| 1 | 0.0004 | 0 4700 | | 0.0045 | 4 | | | 0.1000 | 0.0700 |
| 1.64 | 2,6483 | 2.4877 | 2.3980 | 2.3402 | 4.04 | 8,8759 | 8.5058 | 8,2994 | 8,1669 |
| 1.58 | 2,7096 | 2,5469 | 2.4559 | 2.3974 | 4.08 | 9,0232 | 8,6484 | 8.4394 | 8.3051 |
| 1.72 | 2.7724 | 2.6074 | 2.5152 | 2,4558 | 4.12 | 9.1719 | 8,7923 | 8.5807 | 8.4447 |
| 1.76 | 2,8367 | 2,6694 | 2.5758 | 2.5157 | 4.16 | 9,3221 | 8.9377 | 8.7233 | 8,5857 |
| 1.80 | 2.9024 | 2.7328 | 2,6379 | 2,5769 | 4.20 | 9.4737 | 9.0844 | 8.8673 | 8,7280 |
| 1.84 | 2.9695 | 2.7975 | 2.7013 | 2.6394 | 4.24 | 9.6267 | 9.2325 | 9.0127 | 8.9716 |
| 1,88 | 3.0382 | 2.8637 | 2.7661 | 2.7034 | 4.28 | 9.7811 | 9.3819 | 9.1594 | 9.0166 |
| 1.92 | 3,1082 | 2.9313 | 2.8323 | 2,9353 | 4.36 | 9.9370 | 9.5328 | 9.3075 | 9.1629 |
| 1.30 | J •1791 | 0.0000 | 210000 | 2.5000 | 4.00 | 10.0340 | 3.0000 | 3.4003 | 3.0100 |
| 2.00 | 3.2527 | 3.0706 | 2.9688 | 2,9033 | 4.40 | 10.2530 | 9.8386 | 9.6077 | 9.4596 |
| 2.04 | 3.3271 | 3.1424 | 3.0391 | 2.9727 | 4.44 | 10.4130 | 9.9936 | 9.7599 | 9.6099 |
| 2.08 | 3.48029 | 3.2902 | 3,1939 | 3.1155 | 4.48 | 10.7375 | 10.1499 | 10.0682 | 9.0147 |
| 2.16 | 3,5589 | 3.3662 | 3.2583 | 3,1889 | 4.56 | 10.9019 | 10.4668 | 10.2245 | 10.0690 |
| | _ | | | | | | | | |
| 2.20 | 3.6391 | 3.4430 | 3.3341 | 3.2638 | 4.60 | 11.0677 | 10.6273 | 10.3820 | 10.2247 |
| 2.28 | 3.8038 | 3.6025 | 3.4899 | 3.4174 | 4.68 | 11.4035 | 10,9524 | 10.7013 | 10.5402 |
| 2.32 | 3.8883 | 3,6841 | 3.5698 | 3.4963 | 4.72 | 11.5735 | 11.1170 | 10.8629 | 10.7000 |
| 2.36 | 3.9742 | 3.7671 | 3.6511 | 3.5766 | 4.76 | 11.7450 | 11.2830 | 11.0259 | 10.8611 |
| 2 40 | 4 0616 | 3 8514 | 3 7338 | 3 6582 | 4.90 | 11.0178 | 11.4504 | 11,1903 | 11.0235 |
| 2.44 | 4.1504 | 3.9372 | 3,9179 | 3.7411 | 4.94 | 12.0921 | 11.6192 | 11.3560 | 11,1873 |
| 2.48 | 4.2407 | 4.0243 | 3,9033 | 3,9254 | 4,98 | 12.2678 | 11.7893 | 11.5230 | 11.3524 |
| 2.52 | 4.3324 | 4.1129 | 3,9901 | 3.9111 | 4.92 | 12.4449 | 11.9608 | 11.6914 | 11.5188 |
| 2.56 | 4,4255 | 4.2028 | 4.0782 | 2°888T | 4,90 | 12.6234 | 13.1994 | 11.801% | TT-0800 |
| 2.60 | 4.5201 | 4.2942 | 4.1678 | 4.0865 | 5.00 | 12.8034 | 12,3079 | 12.0324 | 11,9558 |
| 2.64 | 4.6161 | 4.3869 | 4.2587 | 4.1762 | 5.04 | 12.9848 | 12.4836 | 12,2048 | 12.0263 |
| 2.68 | 4.7135 | 4.4810 | 4.3509 | 4.2673 | 5.08 | 13, 1576 | 12.0606 | 12.5539 | 12.3712 |
| 2.76 | 4.9127 | 4.6734 | 4.5396 | 4.4535 | 5.16 | 13.5374 | 13.0187 | 12.7304 | 12.5457 |
| | | | | | F | | 10 1000 | 10 000- | 10 501 - |
| 2.80 | 5.0144 | 4.7717 | 4.6359 | 4,5436 | 5.20 | 13.7245 | 13,1999 | 12,9083 | 12.7216 |
| 2.88 | 5.2221 | 4.9724 | 4.8328 | 4.7429 | 5.28 | 14.1027 | 13,5663 | 13.2682 | 13.0773 |
| 2.92 | 5.3282 | 5.0749 | 4.9332 | 4.8421 | 5.32 | 14,2940 | 13.7516 | 13,4502 | 13.2572 |
| 2.96 | 5.4356 | 5.1787 | 5.0351 | 4.9427 | 5.36 | 14.4867 | 13,9382 | 13.6335 | 13.4384 |
| 3.00 | 5.5445 | 5.2840 | 5,1383 | 5.0446 | 5.40 | 14,6809 | 14.1262 | 13,8182 | 13.6209 |
| 3.04 | 5.6548 | 5.3906 | 5.2428 | 5.1478 | 5.44 | 14.9763 | 14.3156 | 14.0042 | 13,9048 |
| 3.08 | 5.7665 | 5.4986 | 5.3488 | 5.2524 | 5.48 | 15.0733 | 14.5064 | 14.1916 | 13.9901 |
| 3.12 | 5.9797 | 5.6080 | 5.4560 | 5,3583 | 5.52 | 15.2717 | 14.6986 | 14.5704 | 14.1766 |
| 3.10 | 04994.5 | 0.1788 | 0.0047 | 0.4000 | 5.30 | 10.4714 | 14.0921 | T# 93.04 | T#*20#0 |
| 3.20 | 6.1103 | 5.8309 | 5.6747 | 5,5743 | 5.60 | 15.6727 | 15.0870 | 14.7619 | 14.5538 |
| 3.24 | 6.2278 | 5.9445 | 5.7861 | 5,6843 | 5.64 | 15.8752 | 15.2833 | 14.9547 | 14.7444 |
| 3.28 | 6 4670 | 6.1757 | 5.8988 | 5,9083 | 5.72 | 16,0792 | 15-6800 | 15.3443 | 15,1296 |
| 3.36 | 6.5887 | 6.2934 | 6.1284 | 6.0223 | 5.76 | 16,4915 | 15,8804 | 15,5412 | 15.3242 |
| | | | | | | | • • | S. NA | AZ |
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TABLE VII - VARIATION OF SHAPE PARAMETER H WITH MACH NUMBER M AND VELOCITY-PROFILE PARAMETER N - Concluded

$\left[H = \frac{0^*}{\theta}\right]$

(b) Supersonic flow - Concluded,

| Mach | Veloci | ty-profi | le parama | eter, N | Mach | Veloci | ty-profi | le param | eter, N |
|--------------------------------------|---|---|---|---|-------|---------|----------|----------|---------|
| M | 5 | 7 | 9 | 11 | M | 5 | 7 | 9 | 11 |
| 5.80 | 16.5998 | 16.0822 | 15.7394 | 15.5202 | 8.20 | 31.7843 | 30.7051 | 30.1091 | 29.7299 |
| 5.84 | 16.9094 | 16.2853 | 15.9390 | 15.7175 | 8.24 | 32.0788 | 30.9908 | 30.3898 | 30.0077 |
| 5.98 | 17.1204 | 16.4898 | 16.1399 | 15.9162 | 8.28 | 32.3742 | 31.2778 | 30.6719 | 30.2866 |
| 5.92 | 17.3331 | 16.6957 | 16.3422 | 16.1161 | 8.32 | 32.6721 | 31.5661 | 30.9554 | 30.5670 |
| 5.96 | 17.5469 | 16.9030 | 16.5458 | 16.3175 | 8.36 | 32.9707 | 31.8560 | 31.2402 | 30.8488 |
| 6.00 | 17.7624 | 17.1117 | 16.7508 | 16.5201 | 8.40 | 33.2712 | 32.1471 | 31.5265 | 31.1318 |
| 6.04 | 17.9791 | 17.3217 | 16.9571 | 16.7241 | 8.44 | 33.5727 | 32.4396 | 31.9139 | 31.4162 |
| 6.08 | 18.1971 | 17.5331 | 17.1648 | 16.9294 | 8.43 | 33.9751 | 32.7336 | 32.1029 | 31.7020 |
| 6.12 | 18.4168 | 17.7459 | 17.3739 | 17.1361 | 8.52 | 34.1800 | 33.0288 | 32.3931 | 31.9889 |
| 6.16 | 18.6378 | 17.9601 | 17.5843 | 17.3441 | 8.56 | 34.4857 | 33.3254 | 32.6847 | 32.2774 |
| 6.20 | 18.8603 | 18.1755 | 17.7960 | 17.5535 | 8.60 | 34.7932 | 33.6234 | 32.9776 | 32.5671 |
| 6.24 | 19.0840 | 18.3925 | 18.0091 | 17.7642 | 8.64 | 35.1020 | 33.9230 | 33.2719 | 32.8583 |
| 6.28 | 19.3091 | 18.6107 | 18.2236 | 17.9763 | 8.69 | 35.4113 | 34.2236 | 33.5676 | 33.1506 |
| 6.32 | 19.5359 | 18.8304 | 18.4394 | 18.1897 | 8.72 | 35.7235 | 34.5258 | 33.8646 | 33.4445 |
| 6.36 | 19.7639 | 19.0514 | 18.6565 | 18.4043 | 8.76 | 36.0363 | 34.8293 | 34.1630 | 33.7395 |
| 6.40 | 19.9936 | 19.2739 | 18.8751 | 18.6204 | 8.80 | 36.3506 | 35.1343 | 34.4627 | 34.0361 |
| 6.44 | 20.2243 | 19.4976 | 19.0949 | 18.8378 | 8.94 | 36.6664 | 35.4406 | 34.7638 | 34.3339 |
| 6.48 | 20.4565 | 19.7228 | 19.3162 | 19.0565 | 8.98 | 36.9828 | 35.7481 | 35.0662 | 34.6330 |
| 6.52 | 20.6904 | 19.9493 | 19.5387 | 19.2766 | 8.92 | 37.3021 | 36.0573 | 35.3700 | 34.9335 |
| 6.56 | 20.9255 | 20.1772 | 19.7627 | 19.4980 | 8.96 | 37.6218 | 36.3677 | 35.6751 | 35.2353 |
| 6.60 | 21.1622 | 20.4065 | 19.9880 | 19.7208 | 9.00 | 37,9438 | 36.6794 | 35.9817 | 35.5384 |
| 6.64 | 21.4000 | 20.6371 | 20.2146 | 19.9449 | 9.04 | 38,2662 | 36.9926 | 36.2894 | 35.8429 |
| 6.68 | 21.6393 | 20.8692 | 20.4426 | 20.1704 | 9.08 | 38,5897 | 37.3072 | 36.5986 | 36.1488 |
| 6.72 | 21.8802 | 21.1026 | 20.6720 | 20.3971 | 9.12 | 38,9157 | 37.6230 | 36.9091 | 36.4559 |
| 6.76 | 22.1224 | 21.3374 | 20.9027 | 20.6252 | 9.16 | 39,2421 | 37.9402 | 37.2211 | 36.7646 |
| 6.90 | 22.3662 | 21.5736 | 21.1347 | 20.8548 | 9.20 | 39.5716 | 38.2590 | 37.5344 | 37.0744 |
| 6.84 | 22.6111 | 21.8111 | 21.3681 | 21.0855 | 9.24 | 39.9010 | 38.5789 | 37.9490 | 37.3855 |
| 6.88 | 22.8575 | 22.0500 | 21.6023 | 21.3177 | 9.28 | 40.2313 | 38.9003 | 38.1649 | 37.6981 |
| 6.92 | 23.1056 | 22.2903 | 21.8390 | 21.5512 | 9.32 | 40.5656 | 39.2232 | 38.4823 | 38.0120 |
| 6.96 | 23.3548 | 22.5319 | 22.0765 | 21.7860 | 9.36 | 40.8993 | 39.5474 | 38.8008 | 38.3272 |
| 7.00 | 23.6056 | 22.7749 | 22.3153 | 22.0221 | 9.40 | 41.2352 | 39.8730 | 39.1209 | 38.6437 |
| 7.04 | 23.9576 | 23.0193 | 22.5554 | 22.2596 | 9.44 | 41.5722 | 40.1998 | 39.4422 | 38.9616 |
| 7.08 | 24.1109 | 23.2651 | 22.7970 | 22.4984 | 9.48 | 41.9098 | 40.5280 | 39.7650 | 39.2810 |
| 7.12 | 24.3660 | 23.5122 | 23.0398 | 22.7386 | 9.52 | 42.2506 | 40.9578 | 40.0891 | 39.6014 |
| 7.16 | 24.6223 | 23.7608 | 23.2840 | 22.9801 | 9.56 | 42.5912 | 41.1887 | 40.4145 | 39.9234 |
| 7.20 | 24.8803 | 24.0107 | 23.5296 | 23.2230 | 9.60 | 42.9342 | 41.5212 | 40.7414 | 40.2466 |
| 7.24 | 25.1393 | 24.2619 | 23.7766 | 23.4672 | 9.64 | 43.2781 | 41.8552 | 41.0695 | 40.5713 |
| 7.28 | 25.3996 | 24.5146 | 24.0248 | 23.7127 | 9.68 | 43.6224 | 42.1902 | 41.3991 | 40.8973 |
| 7.32 | 25.6619 | 24.7687 | 24.2745 | 23.9596 | 9.72 | 43.9703 | 42.5267 | 41.7299 | 41.2244 |
| 7.36 | 25.9251 | 25.0240 | 24.5255 | 24.2078 | 9.76 | 44.3183 | 42.8646 | 42.0621 | 41.5532 |
| 7.40 | 26.1903 | 25.2808 | 24.7778 | 24.4574 | 9.80 | 44.6682 | 43.2040 | 42.3956 | 41.8831 |
| 7.44 | 26.4564 | 25.5390 | 25.0316 | 24.7083 | 9.94 | 45.0198 | 43.5448 | 42.7306 | 42.2144 |
| 7.48 | 26.7238 | 25.7985 | 25.2866 | 24.9606 | 9.98 | 45.3714 | 43.8867 | 43.0669 | 42.5471 |
| 7.52 | 26.9935 | 26.0594 | 25.5430 | 25.2142 | 9.92 | 45.7264 | 44.2302 | 43.4045 | 42.8809 |
| 7.56 | 27.2639 | 26.3217 | 25.8008 | 25.4691 | 9.96 | 46.0818 | 44.5750 | 43.7435 | 43.2163 |
| 7.60 7.64 7.68 7.72 7.76 | 27.5359 27.8094 28.0836 28.3602 28.6376 | 26.5853 26.8503 27.1167 27.3846 27.6536 | 26.0600 26.3203 26.5822 26.8453 27.1099 | 25.7253 25.9829 26.2418 26.5021 26.7637 | 10.00 | 46,4388 | 44.9212 | 44.0837 | 43.5531 |
| 7.80 7.84 7.88 7.92 7.96 | 28.9167 29.1971 29.4785 29.7621 30.0467 | 27,9243 28,1962 28,4693 28,7440 29,0201 | 27.3758 27.6430 27.9116 28.1816 28.4528 | 27.0267 27.2910 27.5566 27.8235 28.0919 | | | | | |
| 8.00 8.04 8.08 8.12 8.16 | 30.3328 30.6203 30.9087 31.1995 31.4909 | 29,2975 29,5762 29,8564 30,1379 30,4208 | 28.7255 28.9995 29.2748 29.5515 29.8297 | 28.3616 28.6326 28.9049 29.1786 29.4535 | | | | | |

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Comparison of calculated and experimental boundary-"ayer development along contour-plate center line of 3.84- by 10-inch Mach number 2.09 supersonic tunnel.

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