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ROLLING MOMENTS IN A TRAILING VORTEX FLOW FIELD

By Oden J. McMillan, Richard G. Schwind,
Jack N. Nielsen, and Marnix F. E. Dillenius
Nielsen Engineering & Research, Inc.

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16. Abstract

Pressure distributions are presented which were measured on a wing in close proximity to a tip vortex of known structure generated by a larger, upstream semispan wing. Overall loads calculated by integration of these pressures are checked by independent measurements made with an identical model mounted on a force balance.

Several conventional methods of wing analysis are used to predict the loads on the following wing. Strip theory is shown to give uniformly poor results for loading distribution, although predictions of overall lift and rolling moment are sometimes acceptable. Good results are obtained for overall coefficients and loading distribution by using linearized pressures in vortex-lattice theory in conjunction with a rectilinear vortex. The equivalent relation from reverse-flow theory that can be used to give economic predictions for overall loads is presented.

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SUMMARY

An experimental investigation has been carried out to provide detailed pressure distributions on a wing in close proximity to a tip vortex of known structure generated by a larger, upstream semispan wing. Overall loads calculated by integration of these pressures are checked by independent measurements made with an identical model mounted on a force balance. For certain positions of the following wing, the data are shown to include effects from the unrolled-up portion of the vortex sheet from the generating wing. With the vortex close to the wing, these effects are minimal.

Conventional methods of wing analysis are used to predict the loads on the following wing. Two different versions of strip theory are shown to give uniformly poor results for the loading distribution, although the predictions of overall lift and rolling moment are sometimes acceptable. Modeling the incident vortex with vorticity distributed in the core instead of concentrated at the center is important when the vortex is within a core radius of the wing. Vortex-lattice theory gives good results if the vortex with distributed vorticity is constrained to be rectilinear and the loadings are calculated from linearized pressures. The equivalent relation from reverse-flow theory that can be used to give overall loads is presented. Failure to model accurately the nonlinear contributions to loading is shown to have small impact on the overall results.

INTRODUCTION

There is considerable practical interest in the ability to calculate the loads induced on a wing surface in a free stream by a nearby streamwise vortex. For example, this ability is important in the analysis of the vortex hazard problem for a small aircraft operating in the wake of a larger aircraft. It is also central to the analysis of helicopter rotor systems and to the design of control or lifting surfaces for missiles or aircraft if these surfaces are subject to concentrated vortices generated by the nose or by canards. Several investigators have formulated models for calculating induced loads of this type; varying levels of success have been achieved in terms of prediction of overall effects.

In spite of the fact that there is a voluminous literature on this subject, there exists a need for experimental data of sufficient detail and completeness to evaluate the theoretical methods. With the exception of the investigation of reference 1, the existing data lack either detailed measurements of the distribution of loading on the wing or knowledge of the structure of the approaching vortex; reference 1 deals with the case where the vortex-generating wing is at most of the same span as the following wing. Therefore, previous tests of theories for cases where the vortex core is at all appreciable compared to the scale of the following wing have been in terms of gross effects, or have required critical assumptions with respect to the nature of the vortical flow field involved.

The purpose of the work described herein is to provide measurements of sufficient completeness to allow detailed evaluation of existing theories for loads of this type and to conduct such an evaluation. In the particular cases treated, the loads are measured with the following wing at zero angle of attack using pressure taps; the vortex generator is a larger semispan wing. To allow checking of the overall loads calculated by integration of the measured surface pressures, independent measurements are made using an identical model mounted on a force balance. The theoretical methods evaluated are standard methods of wing analysis.

This report describes the experimental arrangement utilized, presents and analyzes the data. The theoretical methods used are described, detailed comparisons with the measurements are made, and shortcomings of the methods are assessed.

SYMBOLS

a_o	three-dimensional lift-curve slope
a_{o_L}, a_{o_R}	lift-curve slopes for wing portions, equation (18)
AR	aspect ratio of wing portion, equation (17)
b	wing span
c	wing chord
c_ℓ	section-lift coefficient
c_{L_α}	section lift-curve slope
$(c_\ell)_{roll}$	section-lift coefficient for wing in steady roll, equation (17)
C_ℓ	rolling-moment coefficient, $R/q_\infty bS$
$\hat{C}_\ell$	rolling-moment coefficient for force model at zero angle of attack in absence of vortex; tare value
C_L	lift coefficient, $L/q_\infty S$
$\hat{C}_L$	lift coefficient for force model at zero angle of attack in absence of vortex; tare value
C_p	pressure coefficient (based on corrected pressure), $(p - p_\infty)/q_\infty$
I_1, I_2, I_3	exponential integrals, equations (15), (16) and (21)
k	constant in model for leading-edge contribution to section lift, equation (4)
L	lift
p	static pressure corrected for pressure measured at same point on pressure model at zero angle of attack in absence of vortex; also roll angular velocity, positive right wing down
P	ratio of semi-perimeter to span of wing portion, equation (17)
q_∞	free-stream dynamic pressure
r	radial distance from vortex centerline
R	rolling moment, positive right wing down
Re_c	Reynolds number based on the chord of the following wing
s	wing semispan, $b/2$

S	wing area, bc for rectangular wing
t	pseudo time coordinate, equation (1)
v_θ	tangential velocity in vortex, equation (2)
V_∞	free-stream velocity
w_v	component normal to wing of velocity due to vortex, equations (9) and (12)
x,y,z	Cartesian coordinates with origin at the centerline of the leading edge of the following wing, cm, figure 1
y_v,z_v	coordinates of the vortex center assuming the presence of the wing causes no deflection
α	angle of attack
$\Delta y_v,\Delta z_v$	change in location of the vortex center due to deflection caused by the presence of the wing
Γ	circulation of vortex at radius, r, equation (1); positive for counterclockwise rotation
Γ_o	strength of potential vortex; or circulation of vortex at large r
ν	pseudo viscosity, equation (1)

Subscripts

A	pertaining to the aged vortex of equation (1)
G	generating wing
ℓ	lower wing surface
P	pertaining to a potential vortex
S	pertaining to the split-wing version of strip theory
u	upper wing surface
v	vortex
∞	free stream

APPARATUS AND INSTRUMENTATION

The experiment was performed in the wind tunnel which is under the jurisdiction of the U. S. Army Air Mobility Research and Development Laboratory at the NASA/Ames Research Center. This is a closed-circuit, atmospheric tunnel with a test section of rectangular cross section 2.1 meters (7 ft) high by 3.0 meters (10 ft) wide. It is described in more detail in reference 2. The general arrangement and coordinate system used are shown in figure 1. The "generating wing" is a semispan model attached to the tunnel scales with its trailing edge at the center of the tunnel turntable. The geometrical characteristics of this wing are listed in Table I. Its measured lift curve (verified in this investigation) and more geometrical detail are available in reference 3. The "following wing" was mounted by means of a small fuselage to the tunnel traversing system (not shown) with its leading edge two generating-wing chord lengths downstream of the generating wing trailing edge. This streamwise position was chosen to minimize the effects of vortex meander (discussed later) and to coincide with a position where a portion of the velocity field of the vortex had previously been measured (ref. 4). While this close proximity to the generating wing is totally unrepresentative of the vortex hazard problem, minimizing meander and operating in a vortex whose structure is at least partially known greatly facilitate application of theoretical methods. The following wing geometrical characteristics are listed in Table I; the exterior lines of the fuselage are shown in figure 2. Provision was made to pitch the following wing-fuselage assembly relative to the traversing system.

There were actually two following wing-fuselage assemblies of identical exterior shape but of different internal construction and instrumentation. One (the "force model") was fabricated of wood and fiberglass and was mounted to the traversing system through a 2.54 cm (1 in.) diameter Task Mark XIVA force balance (balance center at $x = 2.59$, $y = 0$, $z = -2.54$). The gages used to measure lift and rolling moment were calibrated in the tunnel; the estimated experimental uncertainty for a single measurement of lift is $\pm$ 5 percent, for rolling moment $\pm$ 3 percent. The other assembly (the "pressure model") was fabricated of aluminum and was instrumented with 371 pressure taps distributed in chordwise rows on the upper and lower wing surfaces as shown in figure 3. The taps indicated as missing at a particular section in this figure were either omitted because of manufacturing constraints or were found to leak or to be plugged after assembly of the wing to the fuselage.

The pressure taps were installed in the split wing in one of the two ways shown in figure 4. The stainless steel tubes from the pressure taps were led out through the wing and fuselage interiors and were connected to nine Scanivalve modules (with internally mounted pressure transducers) by 0.75 meter (30 in.) lengths of flexible tubing. The Scanivalve modules were attached to the tunnel traversing mechanism aft of the model. The electrical leads from the transducers were led out through the tunnel floor to the power supplies, signal conditioning equipment, and data acquisition system (described below) located in the tunnel control area. The individual pressure lines were carefully leak checked at several stages in the construction of the model, including after its final installation in the tunnel.

The pressure transducers used were all of the differential type; their reference sides were manifolded to the static pressure from the standard tunnel "q" probe. This static pressure (as well as the total pressure from this probe) was also input to a port on each Scanivalve. Because all pressures recorded were to be converted to pressure coefficient form before use, this procedure effectively allowed each transducer to be calibrated on each cycle of the associated Scanivalve. The ranges of the transducers used varied from 1.72 kPa (0.25 psi) to 17.2 kPa (2.5 psi); pressure taps located nearest the trailing edge were connected to the transducers with the smallest ranges for best resolution.

To allow determination of the mean vortex position under various conditions (which are described later), a dual-beam, two-color backscatter laser Doppler velocimeter furnished by the Large-Scale Aerodynamics Branch at the NASA/Ames Research Center was used. For a given test condition, the two beams were positioned so that on the average they bracketed the vortex core, as described in reference 4, and the mean vortex position was determined from knowledge of the LDV focus location. The LDV beams were made visible by injecting vaporized mineral oil into the tunnel in one of two ways: either a conventional resistance heating smoke wand was placed with its tip near the tip of the generating wing (in which case the vortex was smokefilled in a clear free stream), or the entire tunnel was filled with vapor formed by an air-blast atomizer (in which case the vortex core was clear in a smoky free stream). In this latter technique, the smoke was ducted into the tunnel in the diffuser section just downstream of the test section. Both techniques proved useful in different facets of this investigation.

One final piece of instrumentation was provided to allow assessment of the instantaneous deviation of the vortex from its mean position (meander). This information allows conditional sampling of the data from the force model. Using this procedure, only data collected when the vortex is in its mean position are used to calculate rolling moment and lift. This approach is not possible with the pressure model because of inadequate frequency response of the pressure instrumentation due to the (relatively) long pieces of small diameter tubing required to connect the taps to the Scanivalves. The instrument used to provide this instantaneous-position information is a vorticity meter (sketched in figure 5) specially designed for this purpose. The maximum diameter of the blades is approximately equal to the measured diameter of the vortex core (ref. 4) and the device was constructed to allow rapid response to rotational speed changes (the calculated time constant of this instrument is on the order of 10 m/sec). When the position of the vorticity meter is adjusted to coincide with the mean vortex position, decrease in its rotational speed is an indication of movement of the vortex away from this mean position. By averaging only force model data associated with a vorticity-meter rotational speed which is above some value, and then increasing this threshold value, one can gain an understanding of the sensitivity of vortex-induced lift and rolling moment to deviation from vortex mean position. This approach cannot, of course, eliminate the contribution to these quantities from the meander velocity of the vortex in its mean position. The conditionally sampled data will include this contribution.

The vorticity meter lateral and vertical positions were adjusted to coincide with the mean vortex position (as determined by the LDV) for a given location of the force model. It was always located three following-wing chord lengths downstream of the following-wing leading edge (x = 3c). The response of the vorticity meter to the vortex motion is illustrated in figure 6 which is a tracing of the rotational speed output obtained on an oscillograph for a case where the wing was very close to the vortex. Although no vigorous calibration of the rotational speed was maintained (because only relative values were to be used in the conditional sampling process), it is known that the peak speed obtained in this tracing is in excess of 940 rad/sec (9000 rpm). It is clear from this figure that the frequency response of the vorticity meter is adequate for it to serve as an indicator of relative vortex position.

The data acquisition system in the tunnel can simultaneously digitize up to 12 analog inputs and punch these values on computer cards for later reduction. One of these analog input channels was always used for the output of the "q" probe transducer. In testing with the force model, for each position of the wing relative to the mean vortex position, this system was used to record the instantaneous signals from the balance and vorticity meter at approximately 100 different instants in time. Note that conditional sampling was not practical at data-acquisition time but was done later during data reduction. With the pressure model, the pressure transducer in each of the nine Scanivalves was connected to an analog input channel (after appropriate amplification). Because the Scanivalves had to be cycled through all the ports, a period of about 30 seconds was required to record the pressure field on the whole wing. This process was repeated on the order of 20 times to generate an average of the pressure at each point on the wing.

TEST CONDITIONS AND PROCEDURES

Vortex Structure and Location

As previously mentioned, the streamwise position of the following wing was chosen to coincide with one of the measurement planes in an earlier study of the structure of the tip vortex from this generating wing (ref. 4). In that study, the identical generating wing was mounted in a similar way (vertically) in the test section of the other 2.1 meter by 3.0 meter (7- by 10-foot) wind tunnel at the Ames Research Center and a rapid-scanning LDV was used to obtain lateral traverses of tangential velocity through the vortex core.

Figure 7 shows the resulting profile (for $\alpha_G = 12^o$, $V_\infty = 24$ m/sec) in the streamwise plane of interest here. In this figure, the tangential velocity (corrected for tunnel wall images) is normalized by the free-stream velocity and the radial coordinate is normalized by the span of the generating wing. The center of the vortex is taken to be equidistant between the positions of maximum measured tangential velocity. A reasonable degree of symmetry is exhibited between the two sides of the traverse, except just at the edge of the core ($r/b_G \approx 0.01$) and for $r/b_G \gtrsim 0.08$. One may not, of course, infer any further degree of symmetry for the vortex from this, for this close to the wing one would expect neither that the vortex is axisymmetric nor that it is fully rolled up (e.g., see refs. 1, 5-8). In fact, the small asymmetry noted at large r/b_G in figure 7 may be evidence of the unrolled-up portion of the wake (ref. 7). The effects on the following wing of the unrolled-up portion of the wake are apparent in some of the data discussed in a later section.

Having duly noted that the vortex at this location is not axisymmetric, we will nevertheless proceed to represent its velocity distribution by two axisymmetric models. These models are used later as input to theoretical calculations of the lift and rolling moments induced on the following wing. This approach is dictated by a desire to determine the accuracy achievable by simple modeling, as well as by a lack of detailed data on the asymmetric structure. The two models are shown in figure 7. The first is a simple potential vortex with strength determined by fitting the experimental velocity distribution for $r/b_G > 0.02$. The second has vorticity distributed in accord with that in a two-dimensional, laminar, unsteady vortex (an "aged" vortex):

$$\frac{\Gamma}{\Gamma_o} = 1 - e^{-r^2/4\nu t} \tag{1}$$

This equation can be recast in the form:

$$\frac{rV_\theta}{b_G V_\infty} = \left(\frac{\Gamma_o}{2\pi V_\infty b_G}\right)\left[1 - e^{-(r/b_G)^2 (b_G^2/4\nu t)}\right] \tag{2}$$

In applying this model, Γ_o, the circulation of the vortex at large r, is taken to be equal to the circulation of the potential vortex of the first model. The combination $b_G^2/4\nu t$ is chosen to provide best agreement to the experimental data as replotted in the form of figure 8. As a result of these procedures, $\Gamma_o/2\pi V_\infty b_G = 9.68\times10^{-3}$, $b_G^2/4\nu t = 1.052\times10^4$. It is of some interest to note that Γ_o determined in this way is 77 percent of the value calculated from the maximum* section-lift coefficient measured on this wing at $\alpha_G = 12°$ (as reported in ref. 9). This is suggestive of the extent of the rolling-up process at this streamwise location.

*This maximum c_ℓ occurs for $0.35 \lesssim y/s \lesssim 0.60$.

All data in the present investigation were taken with $V_\infty = 49$ m/sec (160 fps) which corresponds to a dynamic pressure of 1.44 kPa (30 psf). The generating wing was always at $\alpha_G = 12.6°$. Because these values are somewhat different from the conditions used to generate the data of figures 7 and 8 ($V_\infty = 24$ m/sec, $\alpha_G = 12°$), the constants just calculated must be adjusted before they are applied to the present situation. Because the roll-up process is essentially inviscid, no correction is applied for the change in Reynolds number (the V_∞ discrepancy). It is further assumed that the small (0.6°) discrepancy in α_G has no effect on the distribution of vorticity ($b_G^2/4\nu t$ unchanged) but that the effect on the total shed vorticity is linear in α_G. This leads to the final value, $\Gamma_O/2\pi V_\infty b_G = 10.14 \times 10^{-3}$.

The position of the unperturbed vortex (in the absence of a following wing) was established using the LDV described earlier. To allow for positioning of the vorticity meter, it was also necessary to measure the perturbed vortex location at $x/c = 3$ as a function of following-wing position again using the LDV. Because of the window arrangement in the tunnel, this procedure was possible only with the vortex over the left wing. Measurements were made for $y_V/s = -0.5$ over a range of positive z_V/c. The deflection of the vortex from its unperturbed location is shown in figure 9. These deflections were also used to position the vorticity meter for the data taken with the force model for $y_V/s = 0.5$.

Tests with the Force Model

Most of the testing with the force model was done using the arrangement shown in figure 1 (following wing horizontal, angle of attack nominally zero) with the vorticity meter appropriately positioned. The vortex positions at which data were taken are shown in Table 2 along with the run number assigned to that data. Notice that the coordinates in this table are for the unperturbed position of the vortex relative to the force model. Although in these terms the vortex would appear to be beneath the wing (for $z_V/c < 0$), in actuality the wing caused the vortex to deflect upward as shown for $z_V/c > 0$ in figure 9. The minimum z_V/c position shown ($z_V/c = -0.18$) is for the case where the wing was observed to bifurcate the vortex

As is also shown in Table 2, some data were obtained with the following wing vertical (rotated 90° counterclockwise, looking upstream), but still nominally at zero angle of attack. Because the coordinate system shown in figure 1 is taken to be fixed in the model, with the wing vertical a vertical sweep of the model corresponds to varying y_v/s, a lateral sweep to varying z_v/c. Runs taken at the intersection of the lateral and vertical sweeps are listed under both kinds of sweeps in Table 2.

To account for small imperfections in its construction, the loads on the force model were also obtained with the generating wing set to generate zero lift. For this measurement, the force model (still nominally at zero angle of attack) was set horizontal and was located well above the generating wing's wake. These loads ($\hat{C}_L$ = 0.0858, $\hat{C}_\ell$ = -0.00866, run 43) were applied as tares to all the other data from the force model; the resultant values (C_L, C_ℓ) are thus induced solely by the presence of the vortex (under the assumption that for the positions occupied by the following wing, variations in the flow angularity in the free stream are small). The lift curve for the force model was also obtained (runs 43-48).

As previously mentioned, the capability existed for conditionally sampling the data from the force model using the rotational speed output of the vorticity meter as an indication of instantaneous vortex position. Nonlinear effects of small changes in vortex position would be removed from the average values determined in this way, and one would expect the resulting mean values to converge and the standard deviation to be reduced as more of the data where the vortex is "out-of-position" are excluded. However, the effects of decreasing the sample size apparently offset the effects of eliminating data for which the vortex was out-of-position, for no such behavior for mean and standard deviation was observed. Therefore, values from the force model presented in this report are averages of all the samples collected at a given test condition.

Tests with the Pressure Model

All of the testing with the pressure model was done with the pressure instrumented wing horizontal. The vortex positions at which data were obtained are shown in Table 3. As with the force model, the loads in the absence of the vortex were measured (run 69) and all results corrected for these tare values. This process, when applied to the pressure at each tap location, results in C_p, the local pressure coefficient from which the effects of the wing thickness and any construction irregularities have been removed. The lift curve for the pressure model was also measured (runs 50-51, 69-74).

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As mentioned previously, for each run approximately 20 samples of the pressure at each pressure-tap location were recorded. At each tap location, these values were averaged, converted to C_p, and integrated chordwise to define the span loading as follows*:

$$c_\ell = \int_0^1 \frac{p_\ell - p_u}{q_\infty} d(x/c) = \int_0^{.05} \frac{p_\ell - p_u}{q_\infty} d(x/c) + \int_{.05}^{.9} C_{p_\ell} d(x/c)$$

$$- \int_{.05}^{.9} C_{p_u} d(x/c) + \int_{.9}^{1} \frac{p_\ell - p_u}{q_\infty} d(x/c) \qquad (3)$$

The second and third terms on the right-hand side of this equation are evaluated by a straightforward numerical integration of the data using the trapezoidal rule. The fourth term provides a negligible contribution. The first term, however, provides a substantial contribution, although it involves only a small region in the wing which cannot be adequately instrumented with pressure taps in a model of this scale. Therefore, the contribution of this term was modeled by the relation

$$\int_0^{.05} \frac{p_\ell - p_u}{q_\infty} d(x/c) = k(C_{p_\ell} - C_{p_u})\Big|_{\frac{x}{c} = 0.05} \qquad (4)$$

where k was determined to be 0.0639 from two-dimensional section data for an NACA 0012 wing (ref. 10). This procedure should be quite accurate over most of the wing as long as the local angle of attack induced by the vortex does not become too large.

Span loading as calculated by equations (3) and (4) is integrated again to get the overall wing lift and rolling-moment coefficients:

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*This procedure cannot be applied at the fuselage location ($y/s = 0$). No c_ℓ is calculated there.

$$C_L = \frac{L}{q_\infty S} = \frac{1}{2} \int_{-1}^{1} c_\ell d(y/s) \tag{5}$$

$$C_\ell = \frac{R}{q_\infty bS} = \frac{1}{4} \int_{-1}^{1} (y/s) c_\ell d(y/s) \tag{6}$$

These equations, valid for a rectangular wing, are evaluated by the trapezoidal rule making use of the fact that $c_\ell = 0$ at $y/s = \pm 1$. Linear interpolation is used through the fuselage location.

PRESENTATION AND DISCUSSION OF EXPERIMENTAL RESULTS

All of the data acquired in this investigation are tabulated in Appendix A. In this section, selected results are presented and discussed.

The Following Wing in the Absence of the Vortex

In figure 10, the integrated lift coefficients for both the force and pressure models are shown as functions of angle of attack. With the exception of one apparently anomalous data point, the agreement for lift derived from the two models is good (within the uncertainty of the force data, $\pm$ 5 percent). Predictions of the lift curve from a vortex-lattice program (described later) and from the method of reference 11 are shown for comparison and agree with the data to within this same order of accuracy. It is shown in reference 12 that for the low Reynolds number of this test (Re_c = 330,000) the lift curve becomes nonlinear for α greater than about 10°. The error bands on the data points from the force model show the standard deviation of those measurements. Because of the assumptions required to integrate the pressure data, accuracy of these data is best assessed by comparison to the force model data and to the theoretical estimates.

An example of the span loading measured by means of the pressure model is shown in figure 11. A decrease in section lift in the immediate vicinity of the fuselage is evident. Good agreement is shown with span loading calculated by the vortex-lattice program. The break in this calculated curve at the fuselage location indicates that this program as currently configured does not calculate the lift carry-over onto the fuselage.

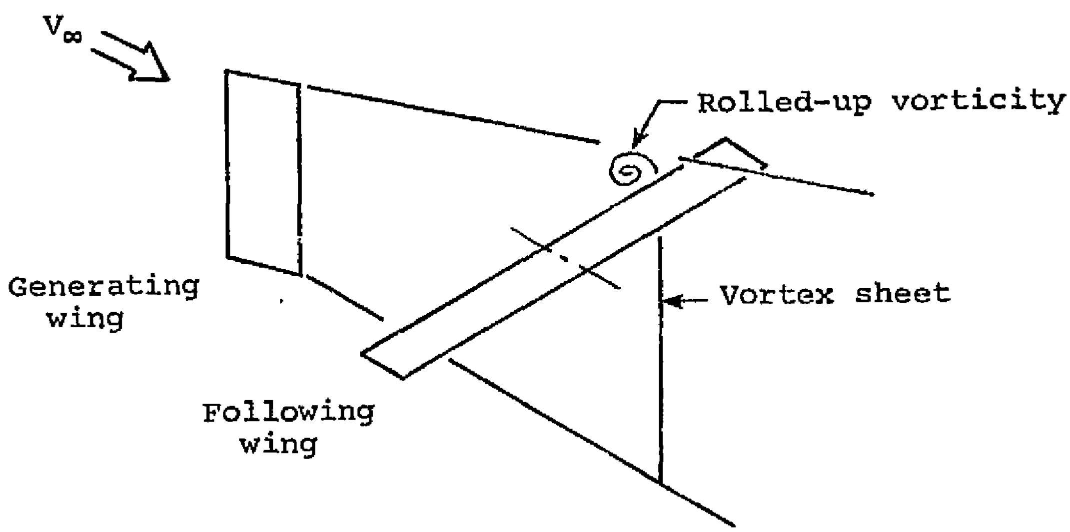
The Following Wing in the Presence of the Vortex

Measured rolling moment and lift are shown in figures 12(a) and (b), respectively, with the vortex at different heights above the right half-semispan. Measurements from the force and pressure models are shown; in both cases, the following model was horizontal. Good repeatability and reasonable agreement between measurements with the different models is evident. The standard deviation of the measurements from the force model in the presence of the vortex is approximately represented by the symbol size in these figures. Note that this approximately bounds the effects of meander in these data.

The span loadings measured on the pressure model at the conditions of figure 12 are shown in figures 13(a) through (f). In these figures, the (unperturbed) position of the vortex relative to the wing and the approximate core size are shown to scale. With the vortex far from the wing, as in figure 13(a), the loading directly under the vortex should be essentially zero. It is seen that c_ℓ is substantially nonzero at $y/s = 0.5$, and that because of the mild gradient of the span loading, the discrepancy is considerably more than could be attributed to uncertainty in the vortex position.* Further, c_ℓ at $y/s = 0.5$ is nearer to zero with the vortex somewhat closer to the wing, figure 13(b). The likely source for this behavior is the unrolled-up portion of the wake from the generating wing; as mentioned earlier, at the streamwise position of the following wing, a substantial amount of the shed vorticity is not rolled up into a symmetric vortex (see sketch on following page). While we propose to do no modeling of the residual vortex sheet to investigate this point further, it is reasonable to suppose that the behavior observed in figures 13(a) and (b) is due to the fact that more of the wing is exposed

*The estimated uncertainty in the unperturbed vortex position is ± 0.02 for y_v/s, ± 0.07 for z_v/c. Movement of the vortex induced by the presence of the wing depends, of course, on the proximity to the wing. At $z_v/c = 1.73$, figure 9 indicates very little lateral movement of the vortex.

to this sheet as the separation between the rolled-up vortex and wing increases; additionally, its effects become proportionally more important as those of the vortex are diminished by distance.



When the vortex is closer to the wing (and the effects of the unrolled-up wake are minimal), one would expect to see evidence of the nonlinear suction lift and vortex-bending contributions to surface pressure discussed in Appendix B. The "bump" in the span loading curves of figures 13(c) and (d) at $y/s = 0.55$ presumably represents these effects (as previously observed in reference 13). Note that because the nonlinear suction and vortex-bending pressures peak directly under the vortex (see Appendix B), this bump is an indication of the perturbed vortex location.

It is reported in reference 13 that when the vortex gets still closer to the wing, bursting occurs and the suction peak disappears. This seems to be the case in figures 13(e) and (f) which have no "bump" at $y/s = 0.55$. Remember that the z_v/c position reported in figure 13 is the unperturbed location. The vortex is bifurcated by the wing in figure 13(f). The span-load distribution remains smooth even for this extreme condition.

Further effects of the unrolled-up wake are evident in figures 14(a) and (b). In these figures, the rolling-moment and lift coefficients measured with the force model are shown for $y_v/s = -0.5$. Measurements are shown with the following model horizontal and vertical. It is clear that changing the attitude of the model relative to the wake causes a substantial change in rolling moment and that this change is increased as z_v/c increases. The effect of lift is seen to be small.

The remainder of the data gathered in this investigation were for varying y_v/s at $z_v/c = 0.05$. These data are shown in figures 15(a) and (b). Measurements with the pressure model horizontal and the force model both horizontal and vertical are included, as are some theoretical results discussed in the next section. The rolling-moment coefficient data of figure 15(a) essentially confirm the above remarks; that is, measurements made with the force and pressure models horizontal agree reasonably well, while those made with the force model vertical show substantial disagreement. The lift-coefficient results of figure 15(b) again show small effects of model attitude.

To illustrate the detailed loading distributions that result in the integrated values presented to this point, a series of isometric plots of the pressure coefficient on the top and bottom wing surfaces is given in figures 16(a) through (f). The position of the vortex for these figures is the same as for figures 13(a) through (f); that is, y_v/s [illegible].5 and z_v/c varies from 1.73 to -0.18. The spanwise station $y_v/s = 0.5$ is marked with an arrow in these figures. The pressure coefficients plotted have been adjusted for the tare run; that is, the pressure distribution due to thickness (and any irregularities in the wing) has been subtracted out. The coefficients measured at taps located forward of $x/c = 0.05$ are not plotted in these figures because they were not used in the integration of loads, as discussed previously. The curve shown at the wing center line on the top surface is the measured pressure distribution there, although it was also not used in the integration. Obviously, no pressures could be measured on the bottom wing surface at the centerline.

In the earlier comments about figures 13(c) and (d), notice was made of the "bump" in the loadings at $y/s = 0.55$. The surface pressures resulting in these loadings are shown in figures 16(c) and (d). Particular attention should be directed to the top wing surface; $y/s = 0.55$ is the spanwise station just to the right of the arrow. The chordwise distribution at this station (and to a lesser degree the distribution at the station marked with the arrow) contrasts markedly with the distributions shown at the other spanwise stations. The (relatively) large negative pressure coefficients existing over the mid and aft portions of the wing at $y/s = 0.55$ result in a locally increased c_ℓ (the "bump"). These augmented pressure coefficients are interpreted as the net of the nonlinear suction lift and vortex-bending contributions. As the vortex

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approaches the wing, figure 16(e), and is bifurcated, figure 16(f), the increased loading over the mid and aft portions of the wing disappears. The pressure distributions far from the vortex in all these figures resemble standard section data and suggest that that portion of the flow field might be modeled in a straightforward fashion using strip theory. The success of this theoretical approach (and others) is assessed in the next section. Some more details of pressure distributions are presented in support of specific points.

DESCRIPTION OF THEORETICAL METHODS AND COMPARISON WITH DATA

Three standard methods of linear wing analysis (strip theory, vortex-lattice theory, and reverse-flow theory) are used to predict the loads on the wing due to the vortex. The boundary conditions used in these calculations consist of the induced velocity field from either a potential vortex or the "aged" vortex of equation (1), with the constants required for the description of the vortex structure determined as described earlier. The methods are applied assuming that the presence of the wing does not alter the vortex structure; that is, the vortex remains rectilinear and the incident velocity field is unchanged from that existing for the isolated vortex. Because the vortex models used take no account of the presence of the unrolled-up vortex sheet discussed earlier, the models are applied only with the vortex close to the wing where the effects of this sheet are minimal.

Strip Theory

Several versions of this simple approach have been applied to this problem in prior investigations, with varying claims of success (see, for example, refs. 1, 7, 14, or 15).

Using strip theory, each infinitesimal element of the wing is considered to be independent of the others, and the load on each element is assumed to be calculable from the local section angle of attack. Thus for a rectangular wing

$$c_L = \frac{1}{2s} \int_{-s}^{s} c_{L_\alpha} \frac{w_v}{V_\infty} \, dy \tag{7}$$

$$c_\ell = \frac{1}{4s^2} \int_{-s}^{s} c_{L_\alpha} y \frac{w_v}{V_\infty} \, dy \tag{8}$$

where c_{L_α} is the section lift-curve slope and w_v/V_∞ is the local section angle of attack. Previous applications of this method differ in the amount of empiricism used in the specification of c_{L_α} and w_v/V_∞.

In this section, two versions of strip theory (differing in the treatment of c_{L_α}) are used to illustrate the fundamental features of the method. In the first version, c_{L_α} is assumed to be constant over the entire wing and equal to a_o, the three-dimensional lift-curve slope (a_o = 4.58/radian = 0.08/degree is used, see fig. 10). Both descriptions of the vortical velocity field developed earlier are used in conjunction with this assumption. If the vortex is to be represented as potential, application of the Biot Savart law yields

$$\left.\frac{w_v}{V_\infty}\right|_P = -\left(\frac{\Gamma_o}{2\pi V_\infty}\right)\frac{y_v - y}{(y_v - y)^2 + z_v^2} \tag{9}$$

and

$$c_{L_P} = \left(\frac{a_o}{4s}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right) \ell n \left[\frac{(y_v - s)^2 + z_v^2}{(y_v + s)^2 + z_v^2}\right] \tag{10}$$

$$c_{\ell_P} = -\left(\frac{a_o}{2s}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right)\left\{1 - \frac{z_v}{2s}\left[\tan^{-1}\left(\frac{y_v + s}{z_v}\right)\right.\right.$$

$$\left.\left. - \tan^{-1}\left(\frac{y_v - s}{z_v}\right)\right] - \frac{y_v}{4s}\, \ell n \left[\frac{(y_v + s)^2 + z_v^2}{(y_v - s)^2 + z_v^2}\right]\right\} \tag{11}$$

If the vortex is represented by equation (1) (an "aged" vortex),

$$\left.\frac{w_v}{V_\infty}\right|_A = \left.\frac{w_v}{V_\infty}\right|_P \left\{1 - e^{-[(y_v - y)^2 + z_v^2]/4\nu t}\right\} \tag{12}$$

and

$$C_{L_A} = C_{L_P} + \left(\frac{a_o}{4s}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right)(I_1 - I_2) \tag{13}$$

$$C_{\ell_A} = C_{\ell_P} - \left(\frac{a_o}{4s^2}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right)\left[\frac{y_v}{2}(I_1 - I_2) - \int_{y_v - s}^{y_v + s} \frac{\eta^2 e^{-(\eta^2 + z_v^2)/4\nu t}}{\eta^2 + z_v^2}\, d\eta\right] \tag{14}$$

The last term on the right-hand side of equation (14) is evaluated numerically. I_1 and I_2 are the exponential integrals

$$I_1 = \int_{t_1}^{\infty} \frac{e^{-t}}{t}\, dt \tag{15}$$

$$I_2 = \int_{t_2}^{\infty} \frac{e^{-t}}{t}\, dt \tag{16}$$

with $t_1 = [(y_v - s)^2 + z_v^2]/4\nu t$ and $t_2 = [(y_v + s)^2 + z_v^2]/4\nu t$.

The second version of strip theory used here is based on the reasoning (set forth in reference 15) that the portions of the wing on either side of the vortex act as separate wings, each with its own (constant) value of lift-curve slope. The lift-curve slope for either portion of the wing is determined from

$$c_{L_\alpha} = \frac{2\pi \mathcal{R}}{P \cdot \mathcal{R} + 2} \tag{17}$$

where $\mathcal{R}$ is the aspect ratio and P is the ratio of semi-perimeter to span, each evaluated for the wing portion treated as a separate wing. Thus for the rectangular wing treated here,

$$\left.\begin{aligned} c_{L_\alpha} = a_{o_L} &= \frac{2\pi\left(\frac{b}{c}\right)\left(1 + \frac{y_v}{s}\right)}{\left(\frac{b}{c}\right)\left(1 + \frac{y_v}{s}\right) + 6} , \quad -1 \le \frac{y}{s} \le \frac{y_v}{s} \\ = a_{o_R} &= \frac{2\pi\left(\frac{b}{c}\right)\left(1 - \frac{y_v}{s}\right)}{\left(\frac{b}{c}\right)\left(1 - \frac{y_v}{s}\right) + 6} , \quad \frac{y_v}{s} \le \frac{y}{s} \le 1 \end{aligned}\right\} \tag{18}$$

Specifying c_{L_∞} as double-valued at y_v/s causes no problems in equation (7) or (8) because w_v/V_∞ vanishes there.

In this second (split-wing) version of strip theory, the aged-vortex relation of equation (12) is used to describe the distribution of section angle of attack. Thus

$$c_{L_{S,A}} = \left(\frac{1}{4s}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right)\left\{a_{o_L}\left[\ln \frac{z_v^2}{(y_v + s)^2 + z_v^2} + I_3 - I_2\right]\right.$$

$$\left. + a_{o_R}\left[\ln \frac{(y_v - s)^2 + z_v^2}{z_v^2} + I_1 - I_3\right]\right\} \tag{19}$$

and

$$C_{L_{S,A}} = -\left(\frac{1}{4s^2}\right)\left(\frac{\Gamma_o}{2\pi V_\infty}\right)\left\{a_{o_L}\left[s + y_v - z_v \tan^{-1}\left(\frac{y_v + s}{z_v}\right)\right.\right.$$

$$+ \frac{y_v}{2} \ln \frac{z_v^2}{(y_v + s)^2 + z_v^2} - \frac{y_v}{2}(I_2 - I_3) - \left.\int_0^{y_v+s} \frac{\eta^2 e^{-(\eta^2+z_v^2)/4\nu t}}{\eta^2 + z_v^2} d\eta\right]$$

$$+ a_{o_R}\left[s - y_v + z_v \tan^{-1}\left(\frac{y_v - s}{z_v}\right) + \frac{y_v}{2} \ln \frac{(y_v - s)^2 + z_v^2}{z_v^2}\right.$$

$$\left.\left. - \frac{y_v}{2}(I_3 - I_1) - \int_0^{s-y_v} \frac{\eta^2 e^{-(\eta^2+z_v^2)/4\nu t}}{\eta^2 + z_v^2} d\eta\right]\right\} \tag{20}$$

where I_3 is the exponential integral

$$I_3 = \int_{\frac{z_v^2}{4\nu t}}^{\infty} \frac{e^{-t}}{t} dt \tag{21}$$

The integrals involving η in equation (20) are evaluated numerically.

Predictions of rolling moment from equations (11), (14), and (20) are shown for $z_v/c = 0.05$ in figure 15(a). The predictions shown ignore the effects of the image vortices present because of the tunnel walls. Inclusion of the closest eight of these images results in very small changes in the coefficients (0.002 in C_ℓ, 0.01 in C_L); the effects of these images are therefore neglected in all subsequent calculations.

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It is seen that the best overall agreement with data is obtained for the approach of equation (14) which uses $c_{L_\alpha} = a_o$ for the whole wing in conjunction with the aged vortex. However, the agreement attained by this method is quite variable. Near $y_v/s = 0$, agreement within about 10 percent is attained; at $y_v/s = 0.5$, the discrepancy is nearly 40 percent; but at $y_v/s = 0.9$, there is excellent agreement. Examination of the lift coefficient results of figure 15(b) reveals a similarly varying level of agreement for this method (eq. (13)); here, however, the whole-wing method in conjunction with a potential vortex (eq. (10)) leads to virtually identical results, while the split-wing method (eq. (19)) exhibits considerably improved agreement with data for all y_v/s.

The reason for this seemingly erratic behavior is apparent from examination of the predicted and measured span loadings in figures 17(a) and (b). These figures show cases where the agreement with data for rolling-moment coefficient from equation (14) is poor and excellent, respectively. The span loadings predicted using the whole-wing and split-wing versions of strip theory and equation (12) are shown; that from the whole-wing approach and equation (9) (not shown) differs from the whole-wing, equation (12) approach only in the immediate vicinity of the vortex where $|c_\ell|$ becomes very large. Predictions from vortex-lattice theory are also shown and are discussed later. It is clear in both figures that both versions of strip theory do a poor job of predicting the spanwise distribution of loading. This is particularly obvious near the vortex where the strong spanwise gradients invalidate the assumption of no interference between adjacent strips. Therefore, where strip theory gives good results it is fortuitous. Compensating errors occur at different positions on the wing.

In the context of linear theory, there are two major possible sources for these (offsetting) errors. The first is that mutual interaction between adjacent wing sections is important. The second is that the aged vortex of equation (1) is a poor representation of the velocity field that exists when the vortex is close to the following wing; that is, the previously mentioned deflection and possible bursting of the vortex are not represented by this model and may have strong effects on the induced loading. The first possible source of error is removed by applying vortex-lattice theory (or reverse-flow theory) to the problem with the vortex assumed rectilinear and represented by equation (12). These approaches are now described. The second possible source of error is discussed subsequently.

Vortex-Lattice Theory - Rectilinear Vortex

The vortex-lattice method is an implementation of linear, potential theory wherein the wing and fuselage are represented by a network of distributed singularities. The particular implementation used in this work is described in references 16 and 17. In the present work, it was found adequate to model each wing panel by 20 spanwise rows of 4 chordwise horseshoe vortices. The fuselage is modeled as a circular cylinder with diameter of 4.47 cm (1.75 in.) and its axis coincident with the x-axis shown in figure 1. The image of the incident vortex in this cylinder is required to maintain the flow tangency condition on its surface; a second image at the cylinder's axis is required to maintain the proper circulation at infinity.

Once the wing perturbation velocities are calculated by the linear theory of the vortex-lattice program, they can be used in any desired pressure-velocity relationship to calculate the surface pressures on the wing. These pressures are then integrated to get lift and rolling moment. It is shown in Appendix B that the contributions to surface pressure of the nonlinear terms present in the Bernoulli pressure relation are of the same order and of opposite sign from the contributions due to vortex bending. Therefore, in the present treatment of a rectilinear vortex, it is appropriate to use the linear pressure-velocity relation. However, for illustrative purposes, examples of loadings calculated from Bernoulli pressures are also included.

Integrated rolling moment and lift calculated in these ways are shown in figures 15(a) and (b) which are for $z_v/c = 0.05$; vortex-lattice calculations were made at $y_v/s = 0.2$, 0.5 and 0.9. Except with the vortex very near the wing tip, agreement with the rolling-moment data is good for calculations using either linear or Bernoulli pressures. At $y_v/s = 0.9$, neither method does very well but the method using Bernoulli pressures is slightly better. The agreement with the lift data is of the same order as the agreement between data from the force and pressure models.

As before, examination of the distribution of loading can lend some insight into the behavior of the overall results. Returning to figure 17(a), we see the span loading for a case ($y_v/s = 0.5$) where both linear and Bernoulli pressure calculations resulted in good agreement with data, with the linear pressure calculation doing slightly better. The improvement in span loading gained by accounting for mutual interaction between wing sections is immediately obvious by contrasting the agreement of either vortex-lattice approach to data with that of strip theory. It is seen that the loads are calculated quite well, except in the immediate vicinity of the vortex location. Using the Bernoulli relation leads to no particular improvement here; the agreement is slightly better on the left of the vortex, slightly worse on the right side. The similar behavior shown in figure 17(b) leads to slightly improved agreement using the Bernoulli pressures, because the area to the right of the vortex is off the wing. The span loadings from vortex-lattice theory shown in figure 17(b) result in poorer agreement with data for rolling moment than for lift probably because the area of greatest discrepancy has a large moment arm in the rolling-moment calculation.

Some further understanding of the level of agreement achieved by these vortex-lattice methods is derived by examining the most detailed output of these methods, surface-pressure coefficients. It is particularly instructive to compare the spanwise distribution of pressure at a constant chordwise position. Figures 18(a) and (b) show measured and calculated pressures due to the vortex on the top and bottom wing surfaces, respectively. The measured pressures are for $x/c = 0.65$. The calculated pressures are for $x/c = 0.688$. In this region of the wing, this small discrepancy in chordwise position is not important for the purposes of the present discussion. The pressure distributions on both surfaces emphasize again that the agreement with data achieved is good, except near the vortex. On the upper surface, the calculated suction peak (using Bernoulli pressures) is overemphasized and slightly mislocated, indicating that the vortex has in fact moved slightly to the right. On the lower wing surface (fig. 18(b)), there is also a calculated and a measured suction peak. Here, however, the calculated peak is underemphasized and too far to the right. It is clear from these remarks that while using the Bernoulli pressure relation does qualitatively represent some real effects in the calculation, its use in conjunction with the assumption of an unaltered vortex structure does not lead to improved agreement for loading over a calculation made using linear pressures and a rectilinear vortex. Improvement in the accuracy of prediction would seem to depend on an accurate representation of the effects of the wing on the vortex. The improvements to be gained, however, do not appear to warrant the effort required.

Reverse-Flow Theory

Under the assumption of a rectilinear vortex, reverse-flow theory (refs. 18 and 19) can be used to calculate the induced rolling moment and the theory is equivalent to that of the preceding section. After an initial calculation of the span loading in the appropriate reverse flow, subsequent calculation of rolling moment for any vortex position is reduced to a simple quadrature. Although the loading distribution is not an output of this method, the calculation is of the same accuracy as that of the preceding section. Reverse-flow theory is therefore a very economic approach, as long as details of the loading are not required.

The reverse flow relation for rolling moment is

$$C_\ell = -\frac{1}{4s^2}\int_{-s}^{s}\left(\frac{w_V}{V_\infty}\right)\left(\frac{V_\infty}{p}\right)\left(c_\ell\right)_{roll} dy \tag{22}$$

where $(c_\ell)_{roll}$ is the span loading distribution for the rectangular wing in steady roll at roll angular velocity p. Either vortex model can be used for w_V/V_∞. In this investigation, $(c_\ell)_{roll}$ was calculated using vortex-lattice theory and equation (22) was applied using w_V/V_∞ from equation (12). It was verified that the results from this approach are equivalent to those from vortex-lattice theory (using linear pressures).

Some Remarks on Calculations Including Vortex Bending

As mentioned previously, it is shown in Appendix B that for a point vortex, contributions to loading from vortex bending and nonlinear terms in the Bernoulli pressure relation are of the same order and of opposite sign. To achieve agreement improved over that demonstrated in the previous sections would therefore seem to require satisfactory modeling of vortex bending as well as inclusion of the Bernoulli terms.

The vortex-lattice program used in this investigation incorporates a vortex-tracking scheme based on slender-body theory. This scheme is a simplified version of the analysis for the cruciform wing case discussed in references 19, 20, and 21. It is inappropriate for use here, however, because it does not take into account the upwash field ahead of the rectangular wing which results in the large vertical deflections of the

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vortex shown in figure 9. But even if a more complete tracking scheme were devised, it would not lead to fully satisfactory results for the case with the vortex very close to the wing. In this situation the vorticity is more widely distributed and neither equation (9) nor (12) is applicable; higher order accuracy would require proper accounting for the full mutual interaction of the vortex and the wing.

This requirement is fortunately not of major concern. The accuracy achieved through the straightforward application of strictly linear analysis in conjunction with a rectilinear vortex model should be entirely satisfactory for most purposes.

CONCLUDING REMARKS

This investigation has resulted in detailed measurements of the loads on a wing in close proximity to a tip vortex generated by a larger, upstream semispan wing. These measurements show that over most of the wing these loads are due to the spanwise varying angle of attack induced by the vortex. For a limited range of wing-vortex spacings, there are also contributions to the loading from vortex bending and the nonlinear terms in the Bernoulli pressure relation. It is demonstrated, however, that failure to model these last two effects results in only a small penalty in predictive accuracy.

Good agreement of the integrated pressure measurements with overall loads measured by means of a force balance is attained. With the vortex very much above the wing, however, the data are shown to include effects of the unrolled-up portion of the vortex sheet emanating from the generating wing. These effects are also evident with the following model rolled 90° relative to its normal position.

An attempt was made to minimize the effects of vortex meander on the measurements by conditionally sampling the data, using the output of a vorticity meter to indicate vortex instantaneous position. Because the conditional sampling process used here resulted in reduced sample sizes, no improvements were attained over averages calculated using all the data.

Various theoretical methods were used to compute the loads for the experimental cases for which the effects of the unrolled-up wake are minimal. Straightforward applications of strip theory resulted in a varying level of agreement with the measurements. Comparison of the predicted and measured span loadings reveals uniformly poor accuracy, however, indicating that the limited success strip theory does achieve is fortuitous. In these comparisons, two models for the vortex velocity field were used; one a simple potential vortex, the other allowing for distributed vorticity in the core. Both models are based on previously published LDV traverses of the vortex of interest at the appropriate streamwise station. Allowance for the finite vortical core improved agreement slightly over calculations made with the potential vortex model.

Loads predicted using linearized pressures from vortex-lattice theory applied in conjunction with a rectilinear vortex model (with distributed vorticity) are within about 15 percent of measurements unless the vortex is very close to the wing tip. Agreement with measured span loadings is good except in the immediate vicinity of the vortex. The reverse-flow theorem, which can be used to calculate overall loads to the same accuracy, is presented.

The use of pressures calculated using the Bernoulli relation in conjunction with vortex-lattice theory and a rectilinear vortex does not result in improved agreement for loading although it does improve agreement for pressure distribution somewhat. Improvement in predictions should result from accounting for the interference of the wing on the vortex path, unless the wing is very close to the vortex. In this case, the resultant more widely distributed vorticity would have to be modeled.

In summary, economic predictions of overall loads of sufficient accuracy for most applications can be achieved by using reverse-flow theory. If the predictions are for cases where the vortex is within a core radius of the wing, a vortex model with a core should be used. If detailed loading distributions are required, fully linearized vortex-lattice theory gives good results. Significant improvements in accuracy beyond this situation are likely to be obtained only by accounting fully for mutual wing-vortex interference.

NIELSEN ENGINEERING & RESEARCH, INC.
Mountain View, California
February 1977

TABLE 1.- GEOMETRICAL CHARACTERISTICS OF GENERATING AND FOLLOWING WINGS

	Generating Wing	Following Wing
Section	NACA 0015 (thickened trailing edge)	NACA 0012
Planform	Rectangular	Rectangular
Tip Shape	Squared off	Squared off
Chord, c, cm (in.)	45.7 (18.0)	9.91 (3.90)
Semispan s, cm (in.)	123.2 (48.5)	44.12 (17.37)
Aspect Ratio	5.4	8.9

TABLE 2.- VORTEX POSITIONS, FORCE MODEL

(a) Horizontal Wing, Vertical Sweeps

z_v/c	Run Number $y_v/s = -0.5$	Run Number $y_v/s = 0.5$
1.73	24	25
0.73	27	26
0.23	28	29
0.05	31	30
-.02	37	36
-.18	38	39

(b) Horizontal Wing, Lateral Sweep

y_v/s	Run Number, $z_v/c = 0.05$
-0.5	31
0.	40
0.05	41
0.1	42
0.15	33
0.2	34
0.5	30
0.75	32
0.9	35

(c) Vertical Wing, Vertical Sweep

y_v/s	Run Number, $z_v/c = 0.05$
-0.9	21
-0.5	14,15
-0.2	20
-0.1	18,19
0.	16,17

(d) Vertical Wing, Lateral Sweep

z_v/c	Run Number, $y_v/s = -0.5$
0.23	11,12
0.05	14,15
-0.18	13

TABLE 3.- VORTEX POSITIONS,
PRESSURE MODEL, HORIZONTAL WING

(a) Vertical Sweep

z_v/c	Run Number, $y_v/s = 0.5$
1.73	66
0.73	54,67
0.23	53,68
0.05	60
-0.02	63
-0.18	58

(b) Lateral Sweep

y_v/s	Run Number, $z_v/c = .05$
-0.5	62
0.	64
0.1	65
0.2	61
0.475	56
0.5	60
0.525	57
0.9	59

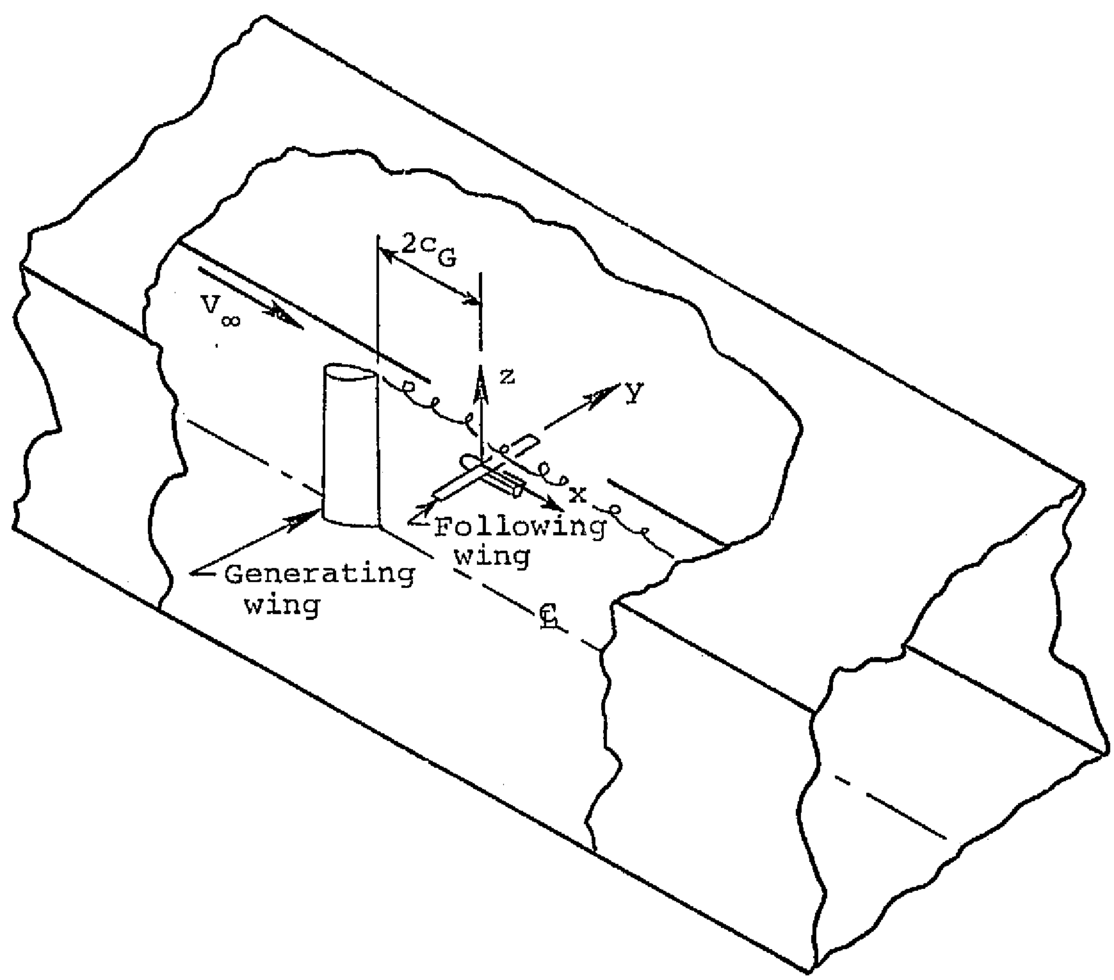
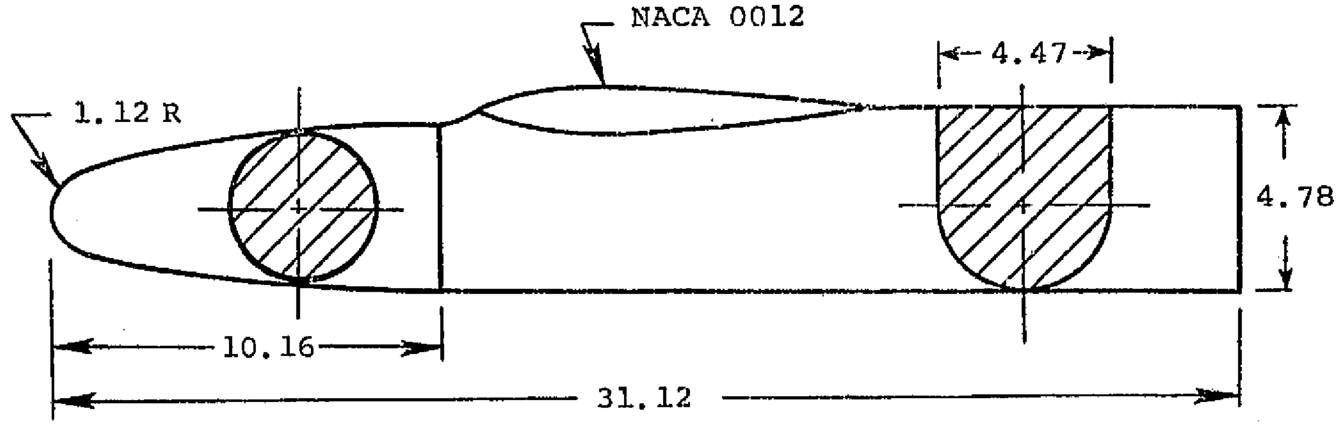


Figure 1.- Experimental arrangement.

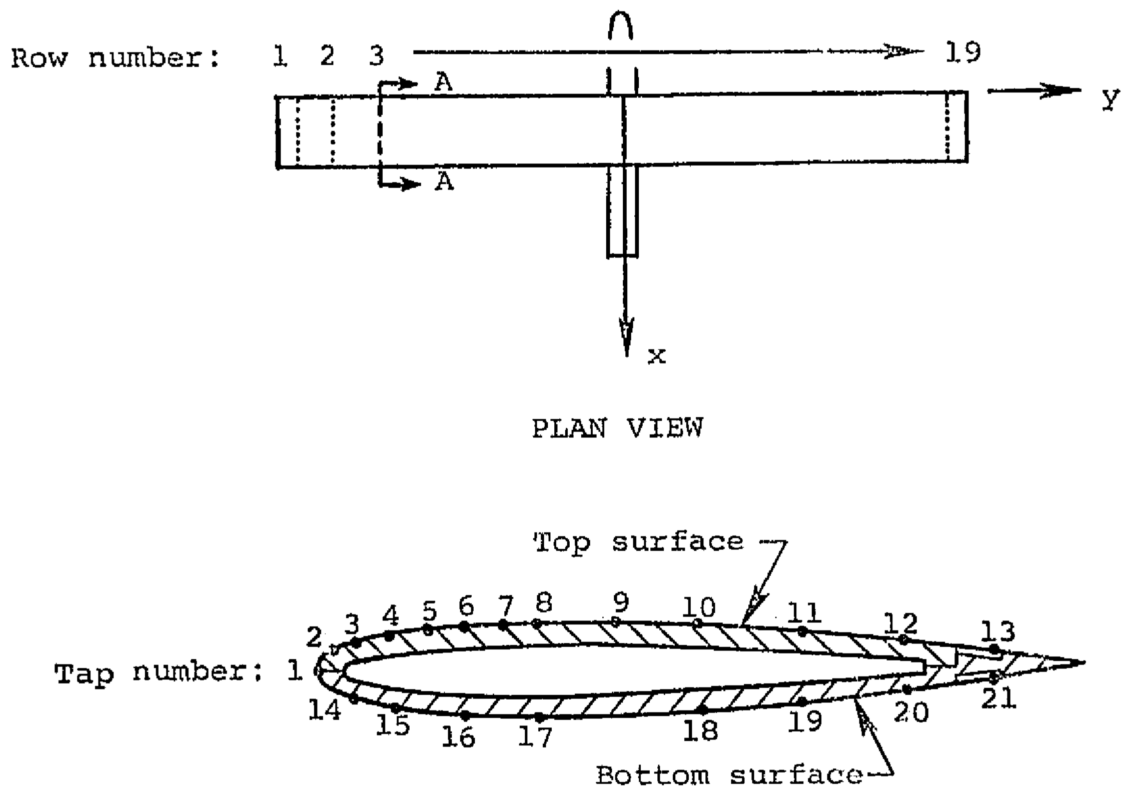
(All dimensions in cm)



NOSE SHAPE

Distance from Tip	Diameter
0.76	2.16
2.03	2.82
3.30	3.30
4.57	3.66
7.11	4.27
9.65	4.44
10.16	4.44

Figure 2.- Fuselage exterior shape.



SECTION A-A (Note change of scale)

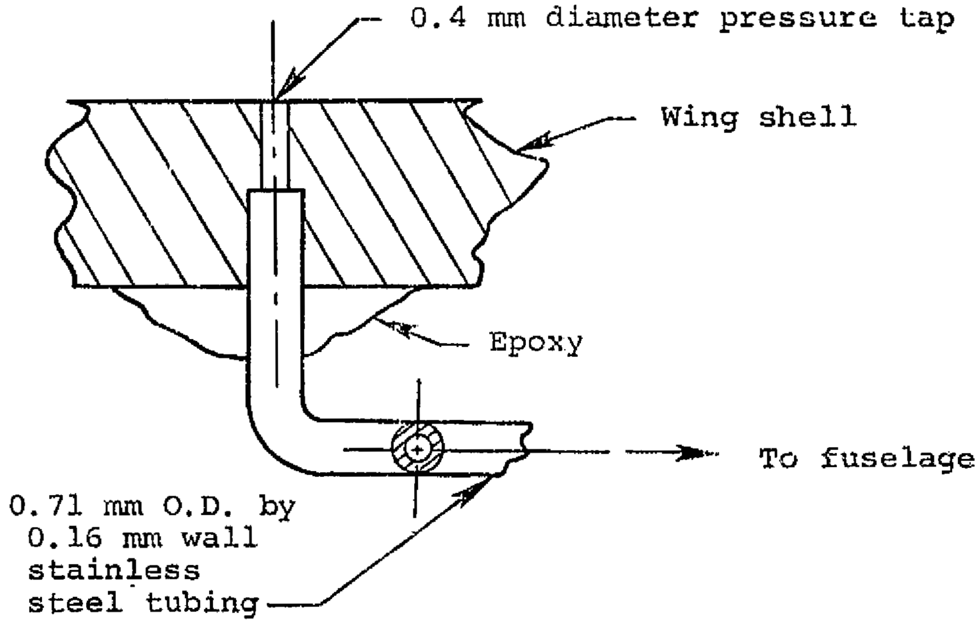
Chordwise Location

Tap Number (I)	x/c
1	0
2	0.025
3,14	0.050
4,15	0.100
5	0.150
6,16	0.200
7	0.250
8,17	0.300
9	0.400
10,18	0.500
11,19	0.650
12,20	0.780
13,21	0.900

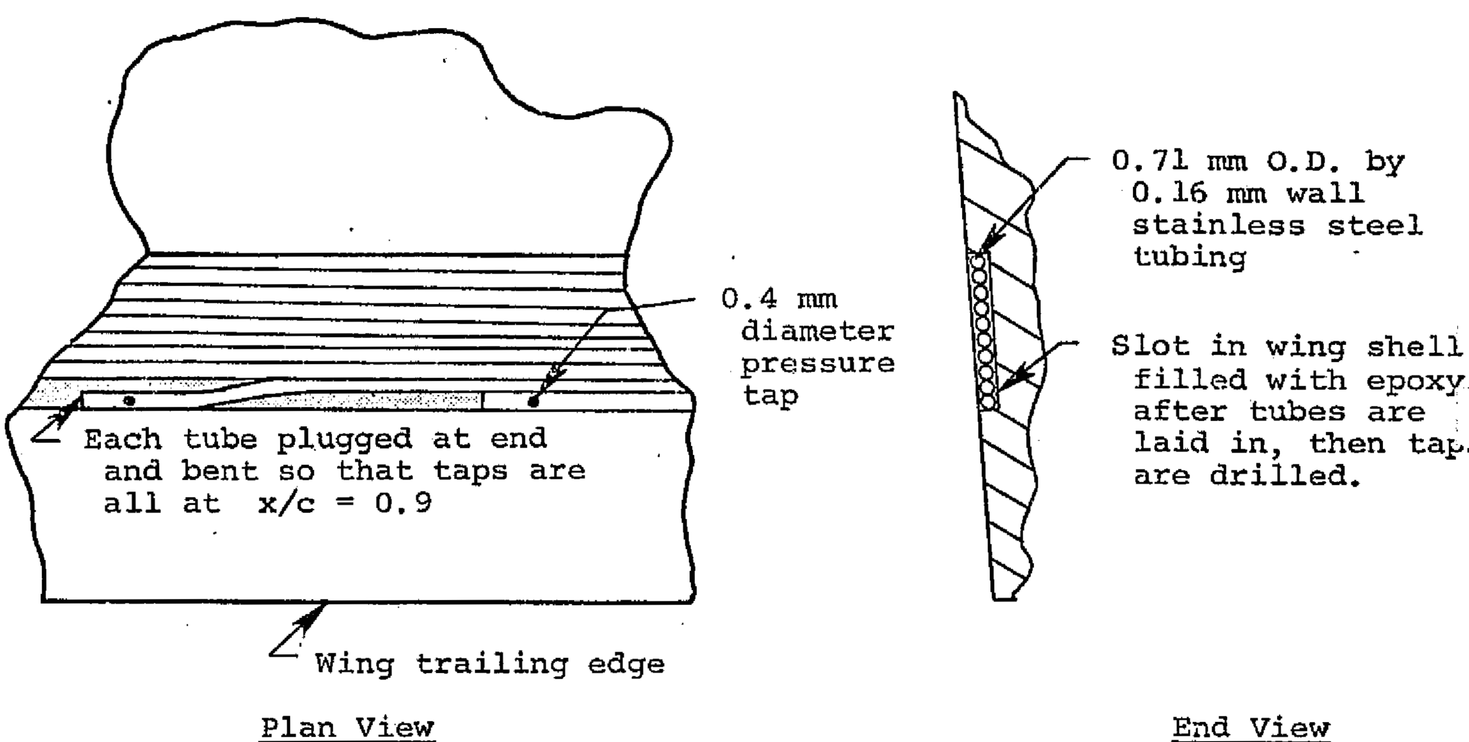
Spanwise Location

Row Number (J)	y/s	Missing Tap Numbers
1	-0.95	11
2	-0.85	
3	-0.70	1
4	-0.50	
5	-0.40	1
6	-0.25	
7	-0.10	
8	-0.06	18
9	0.00	8, 9,13-21
10	0.10	11,19
11	0.25	9,10
12	0.40	1
13	0.45	1,10
14	0.50	10
15	0.55	6
16	0.60	9,10
17	0.75	9
18	0.85	
19	0.95	8, 9

Figure 3.- Pressure tap locations.



(a) Typical construction, taps 1-12, 14-20.



(b) Typical construction, taps 13 and 21.

Figure 4.- Pressure tap construction.

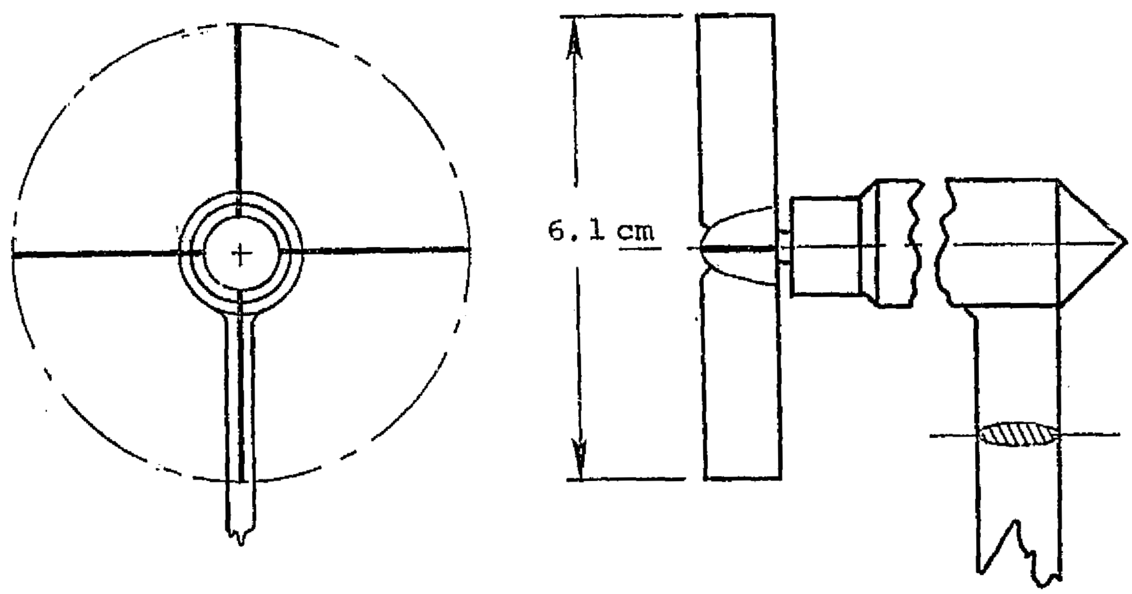


Figure 5.- Schematic of vorticity meter.

Figure 6.- Vorticity meter output.

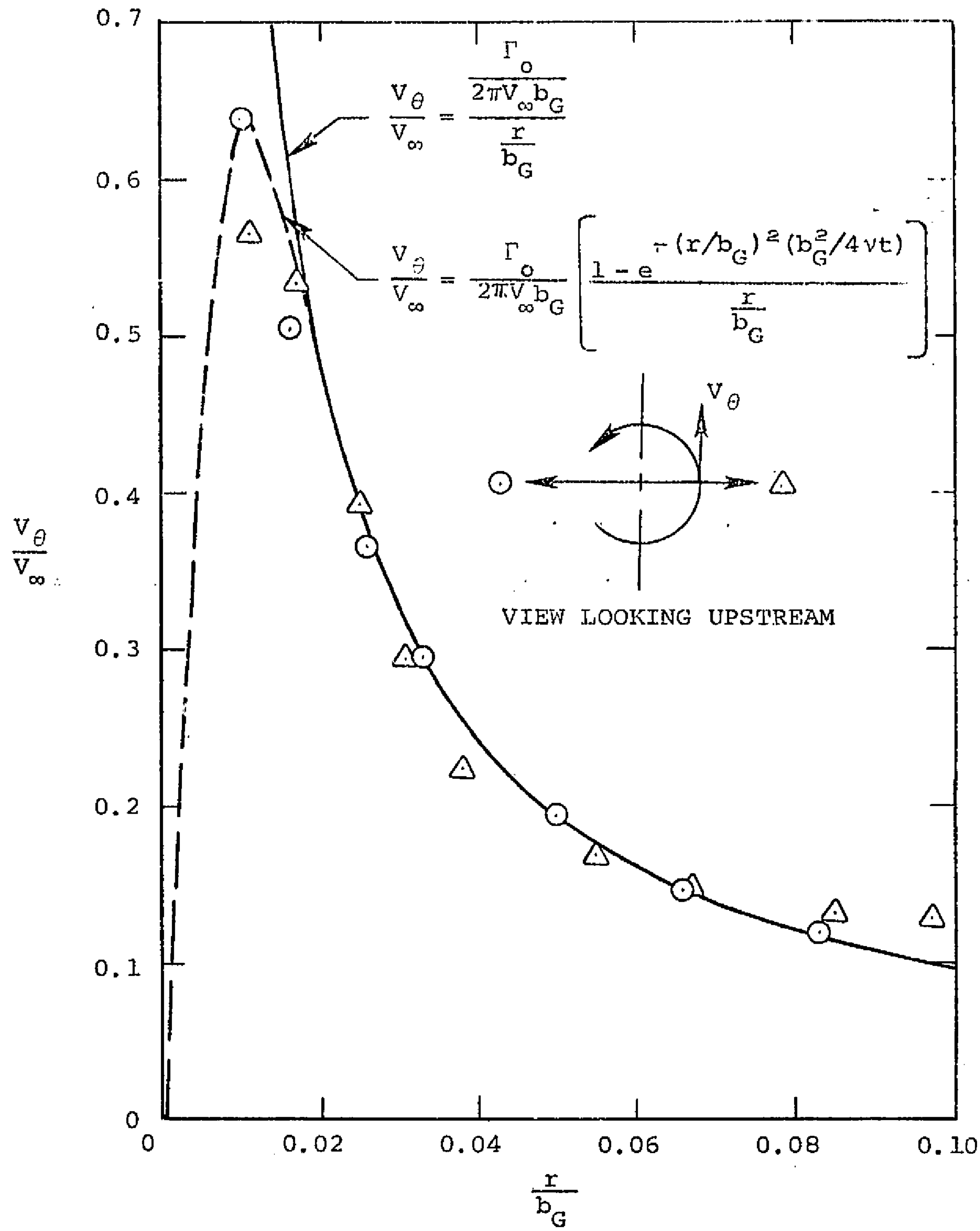


Figure 7.- Tangential velocity profile through vortex core (from ref. 4), two chord lengths downstream of generating wing. V_∞ = 24 m/sec, $\alpha_G = 12^\circ$.

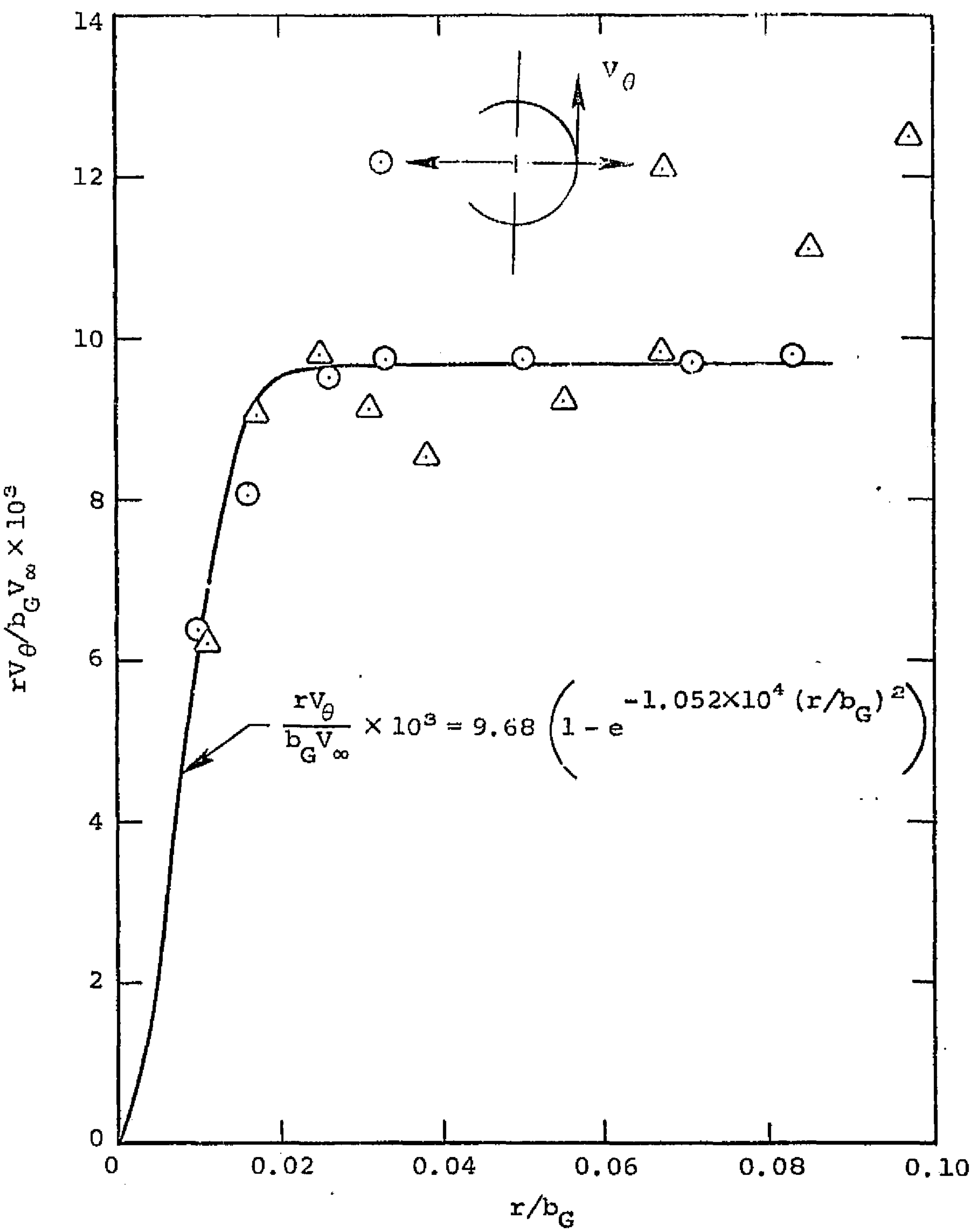


Figure 8.- Vortex circulation as a function of radius.

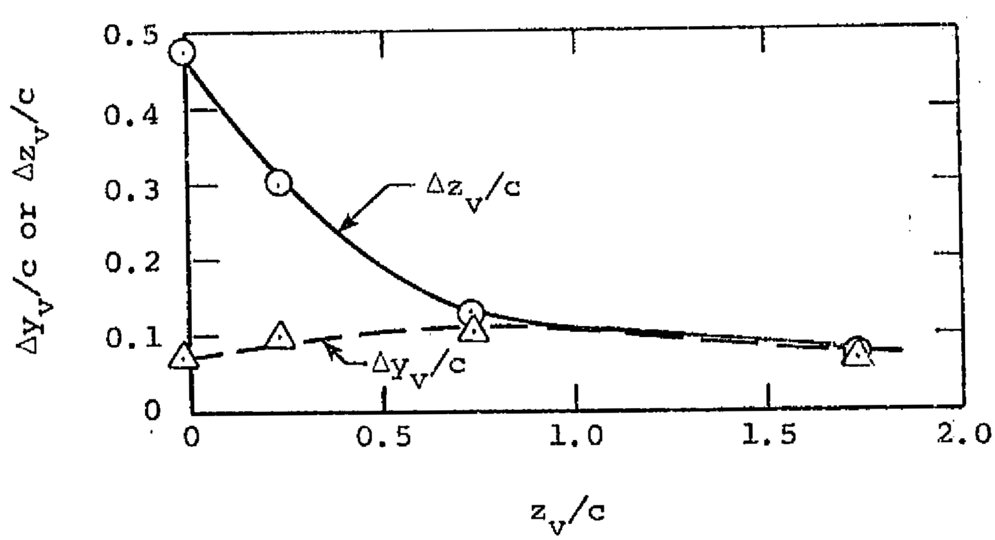


Figure 9.- Lateral and vertical deflection of vortex from its unperturbed position, as measured behind the wing ($x/c = 3$). $y_v/s = -0.5$.

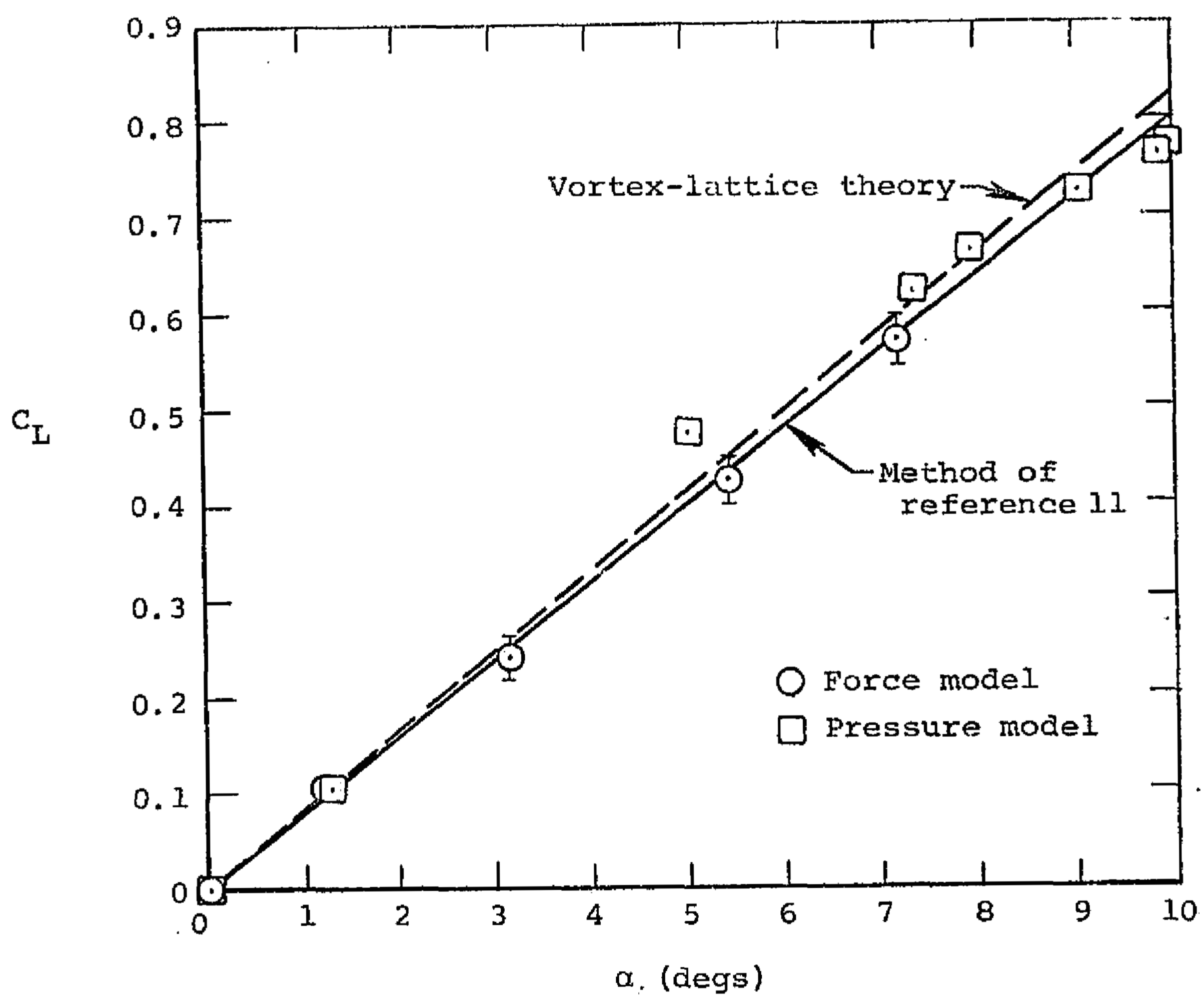


Figure 10.- Lift curve of the following wing.

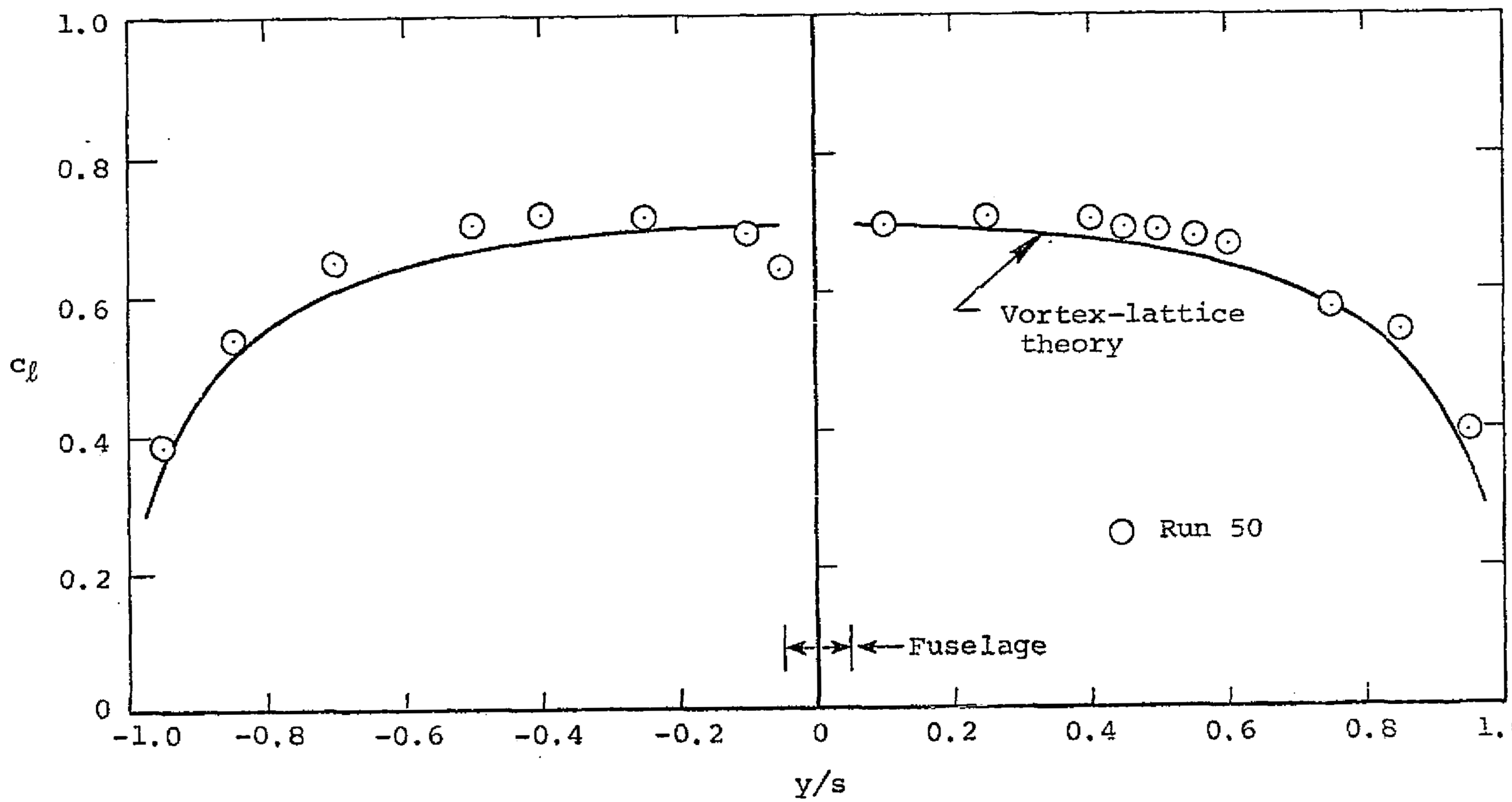
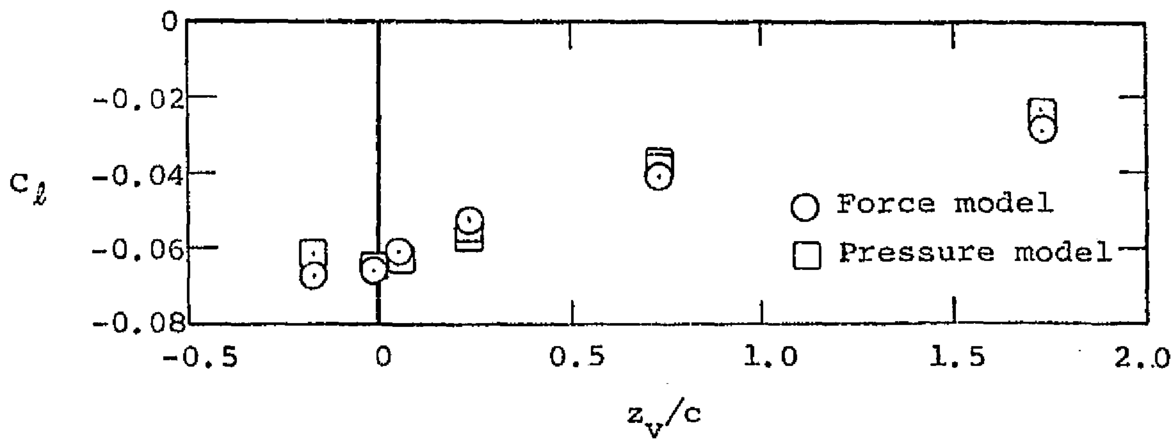
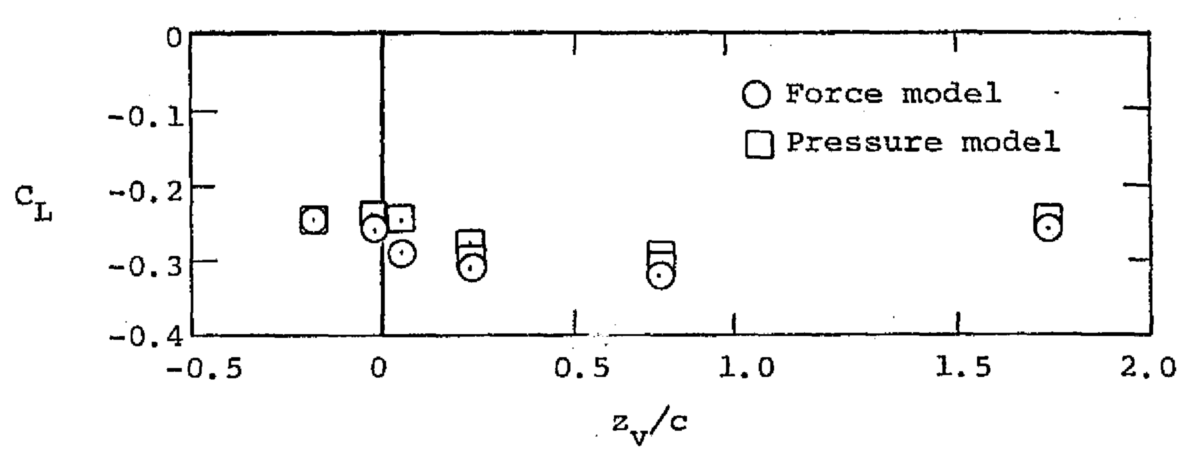


Figure 11.- Span loading of the following wing, $\alpha = 7.4^\circ$.

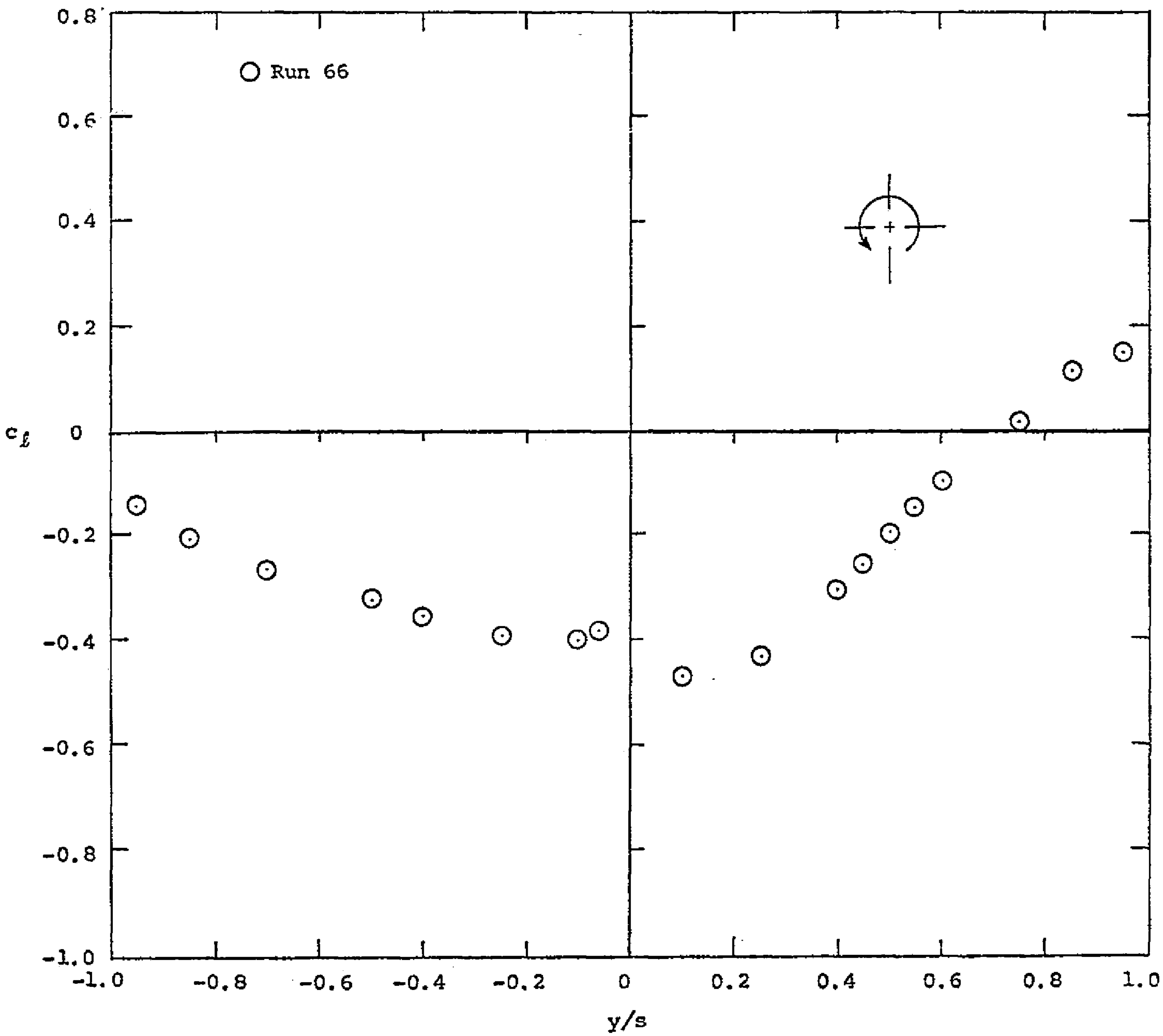


(a) Rolling-moment coefficient.



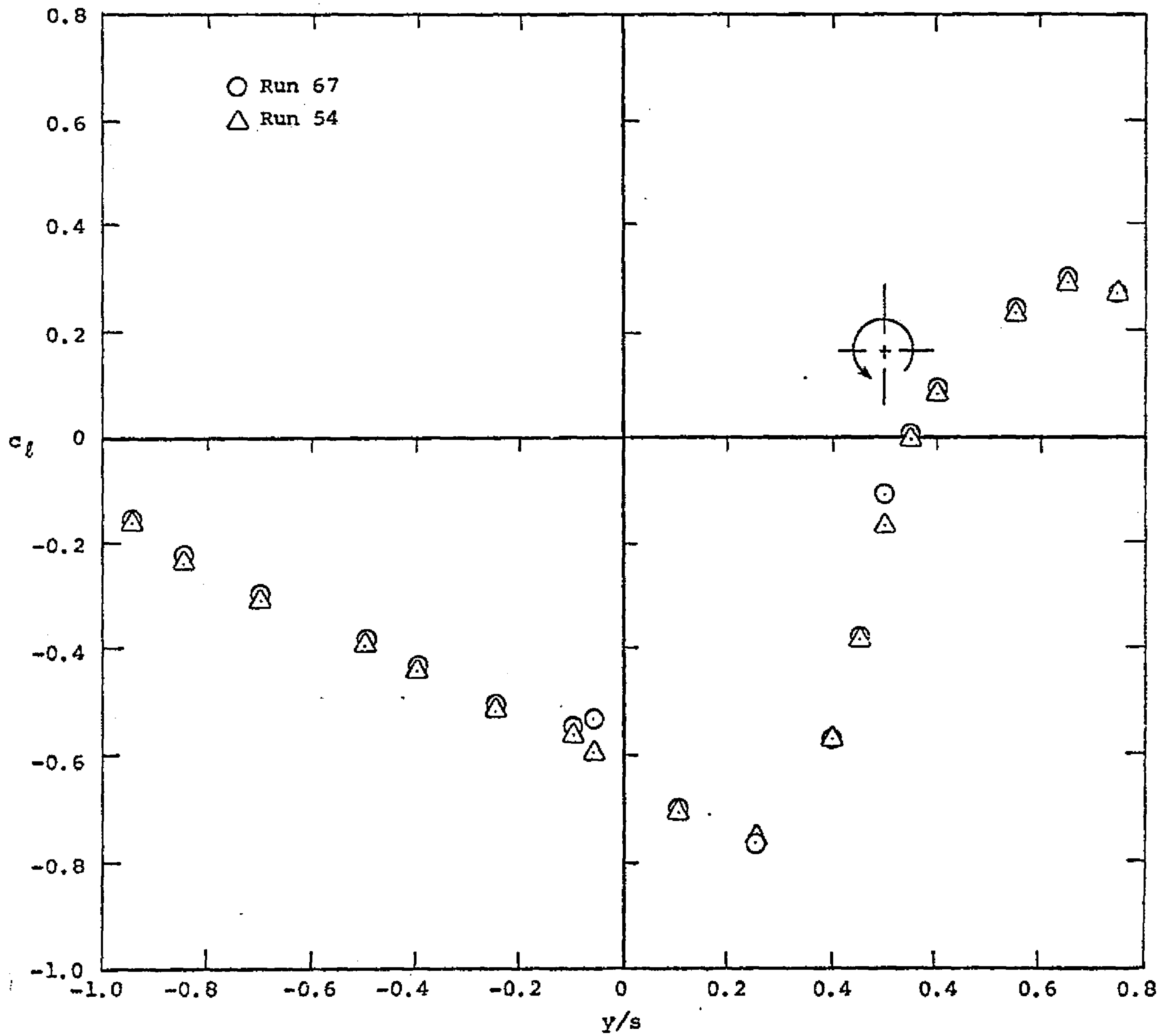
(b) Lift coefficient.

Figure 12.- Measured rolling moment and lift, $y_v/s = 0.5$, horizontal wing.



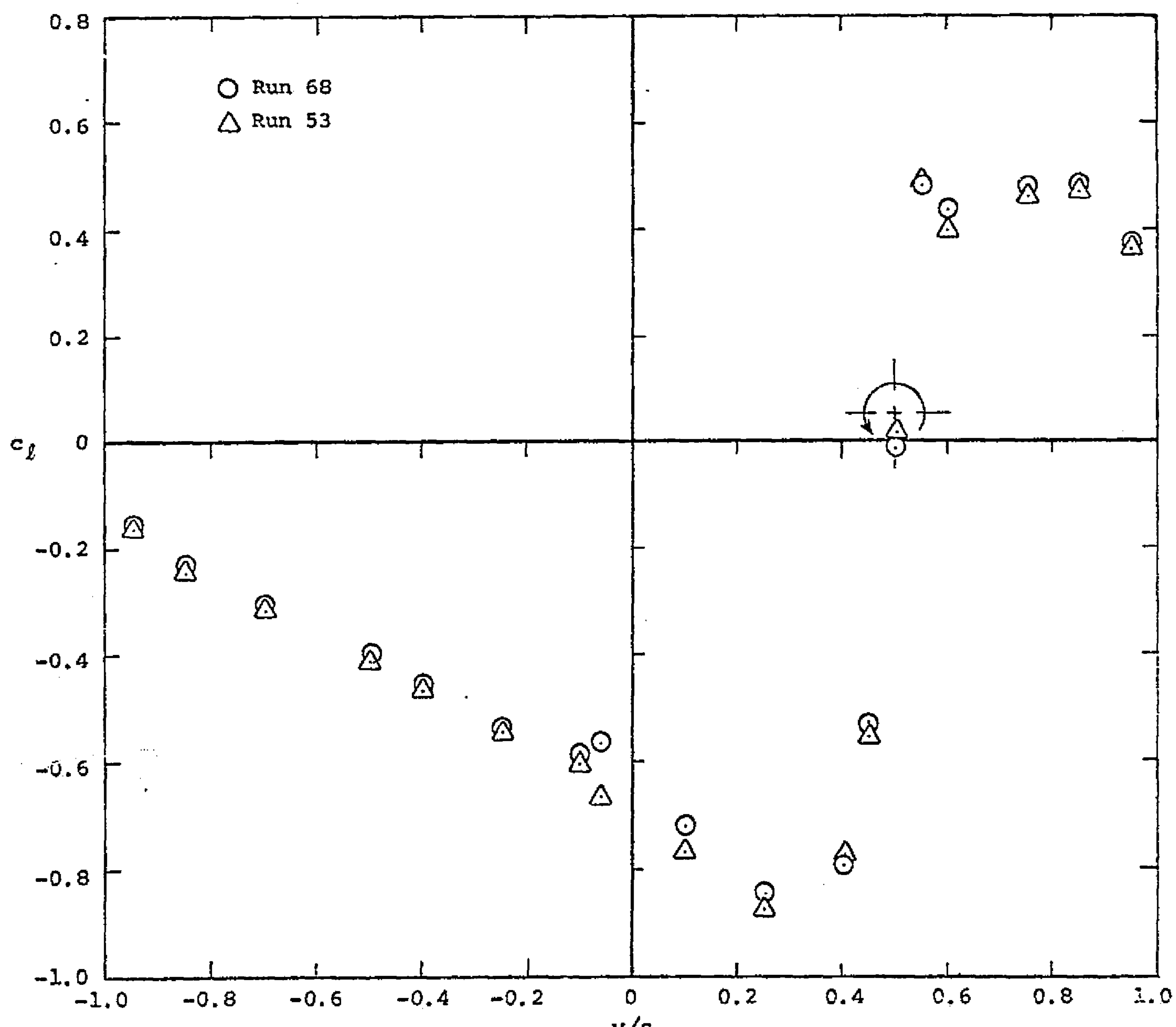
(a) $z_v/c = 1.73$.

Figure 13.- Span loading of the following wing, $y_v/s = 0.5$.



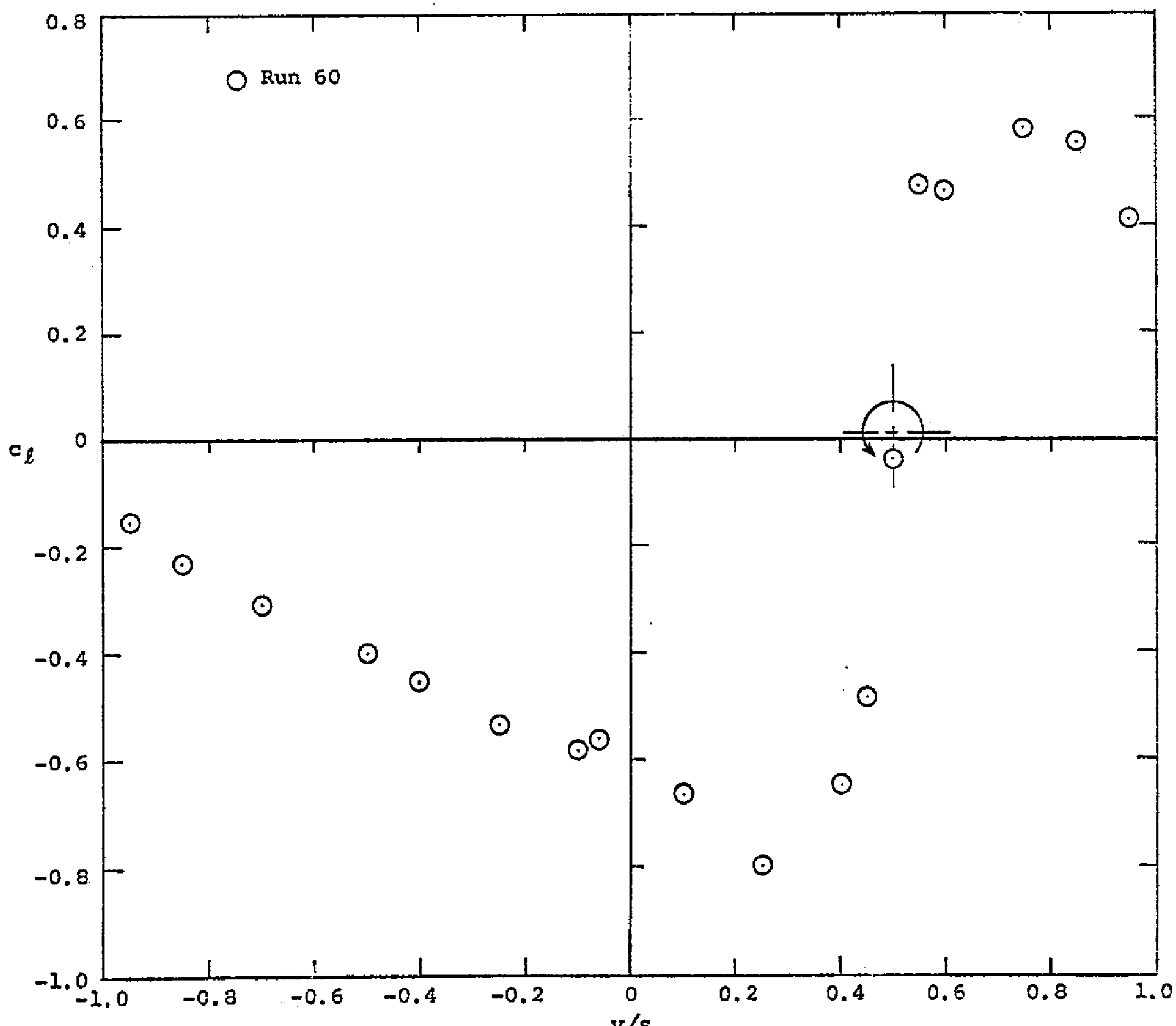
(b) $z_v/c = 0.73$.

Figure 1? - Continued.



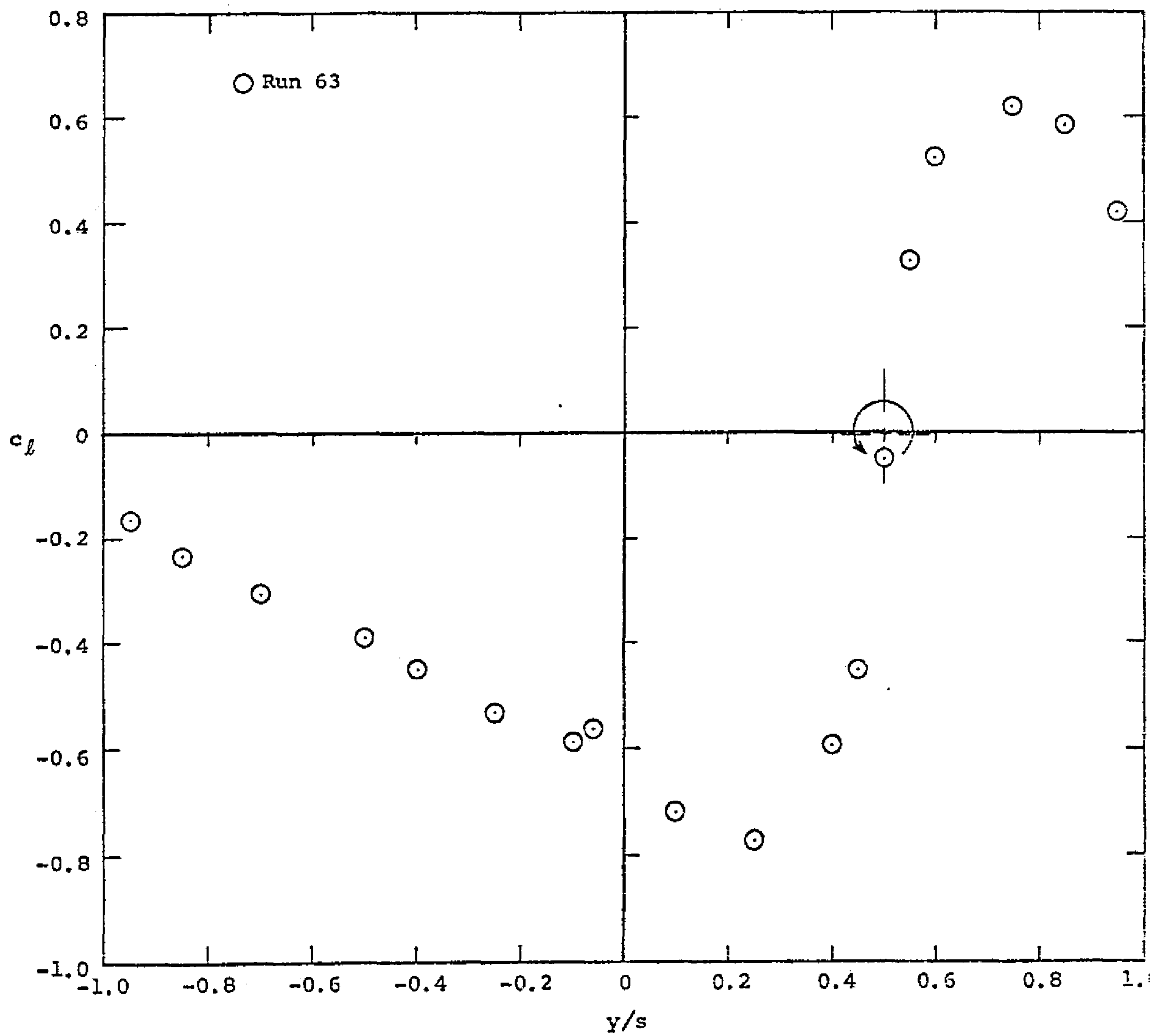
(c) $z_v/c = 0.23$.

Figure 13.- Continued.



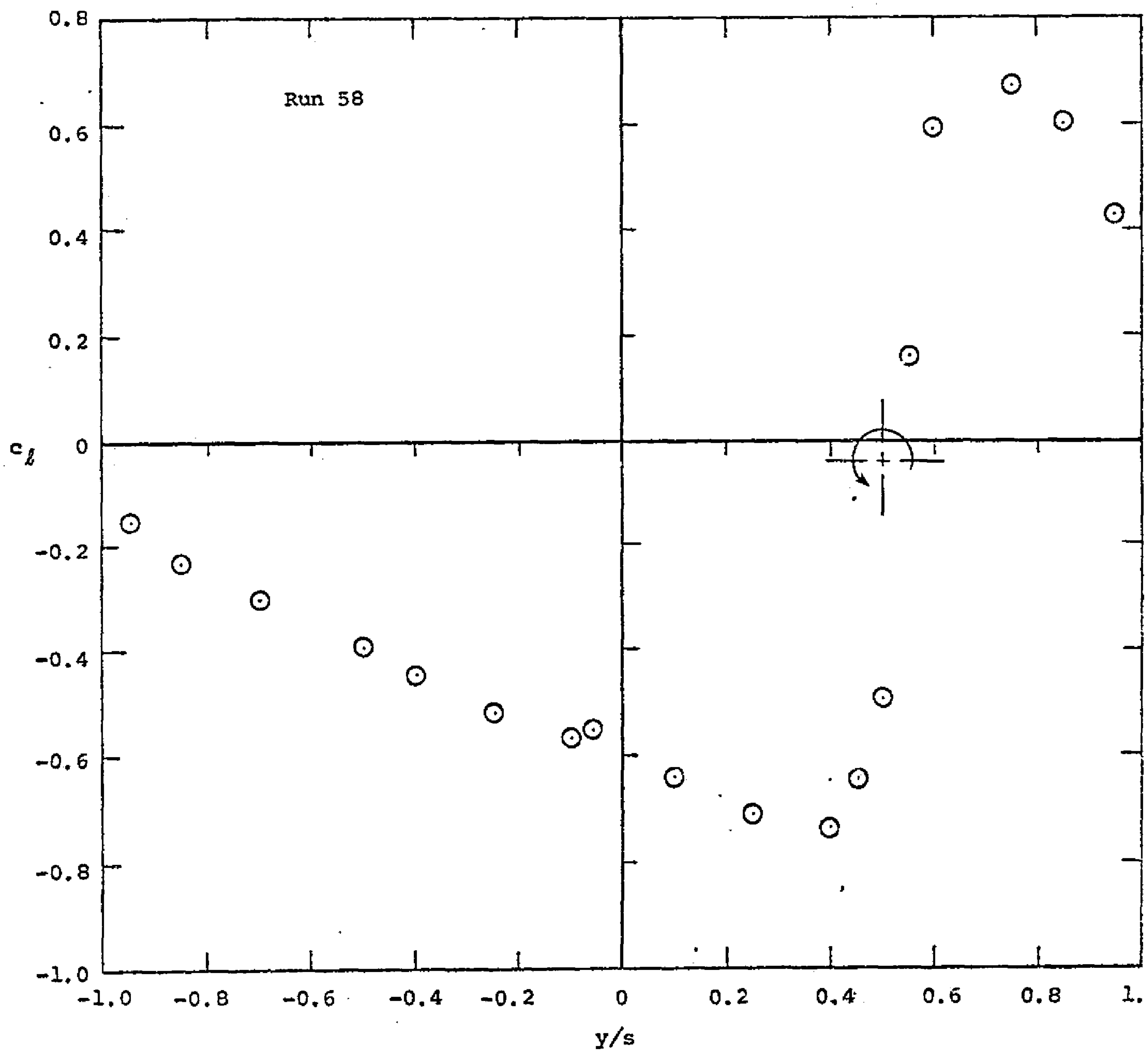
Run 60
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
c_ℓ
-1.0
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1.0
y/s

(d) z_v/c = 0.05.



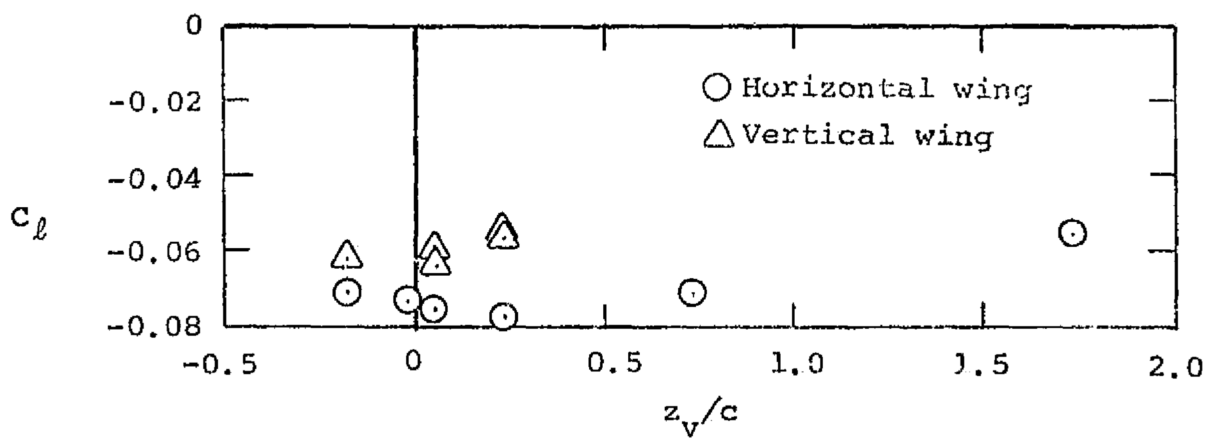
(e) $z_v/c = -0.02$.

Figure 13.- Continued.

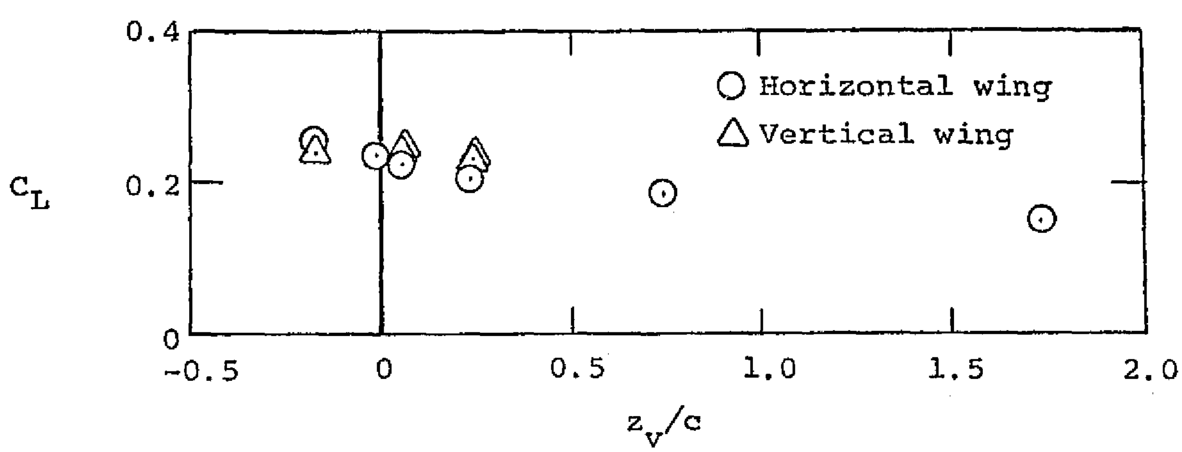


(f) $z_v/c = -0.18$

Figure 13.- Concluded.

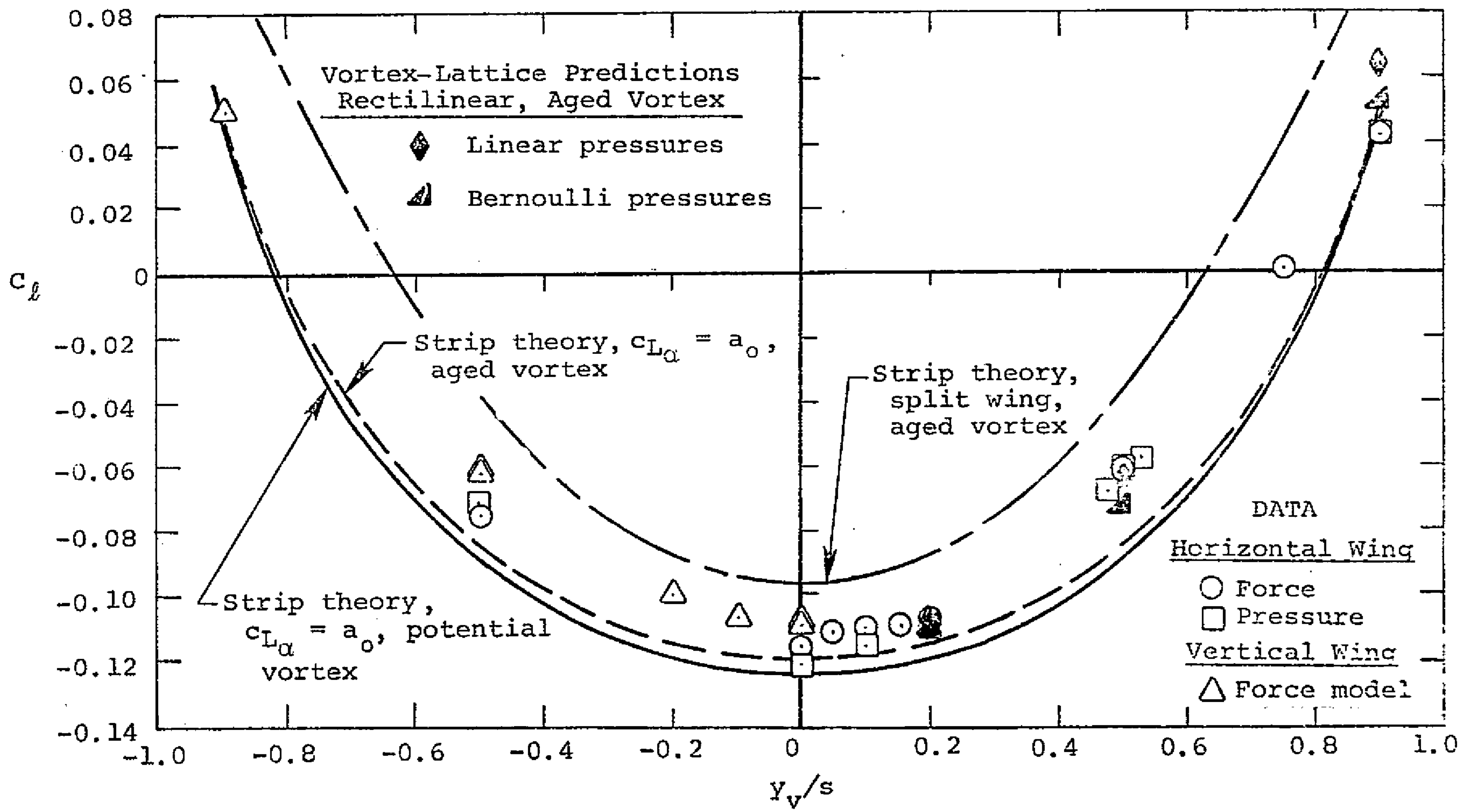


(a) Rolling-moment coefficient.



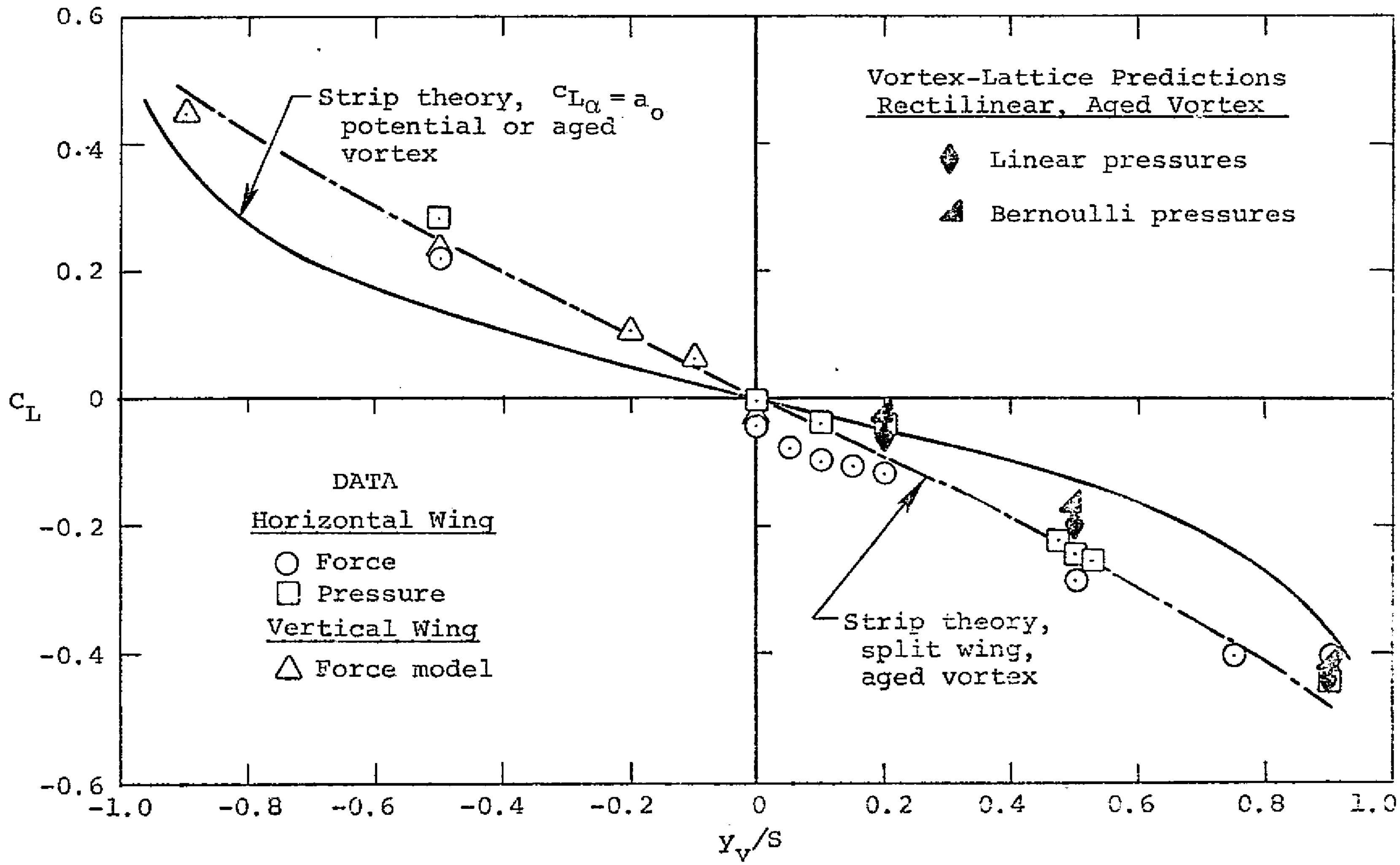
(b) Lift coefficient.

Figure 14.- Measured rolling moment and lift, $y_v/s = -0.5$, force model.



(a) Rolling-moment coefficient.

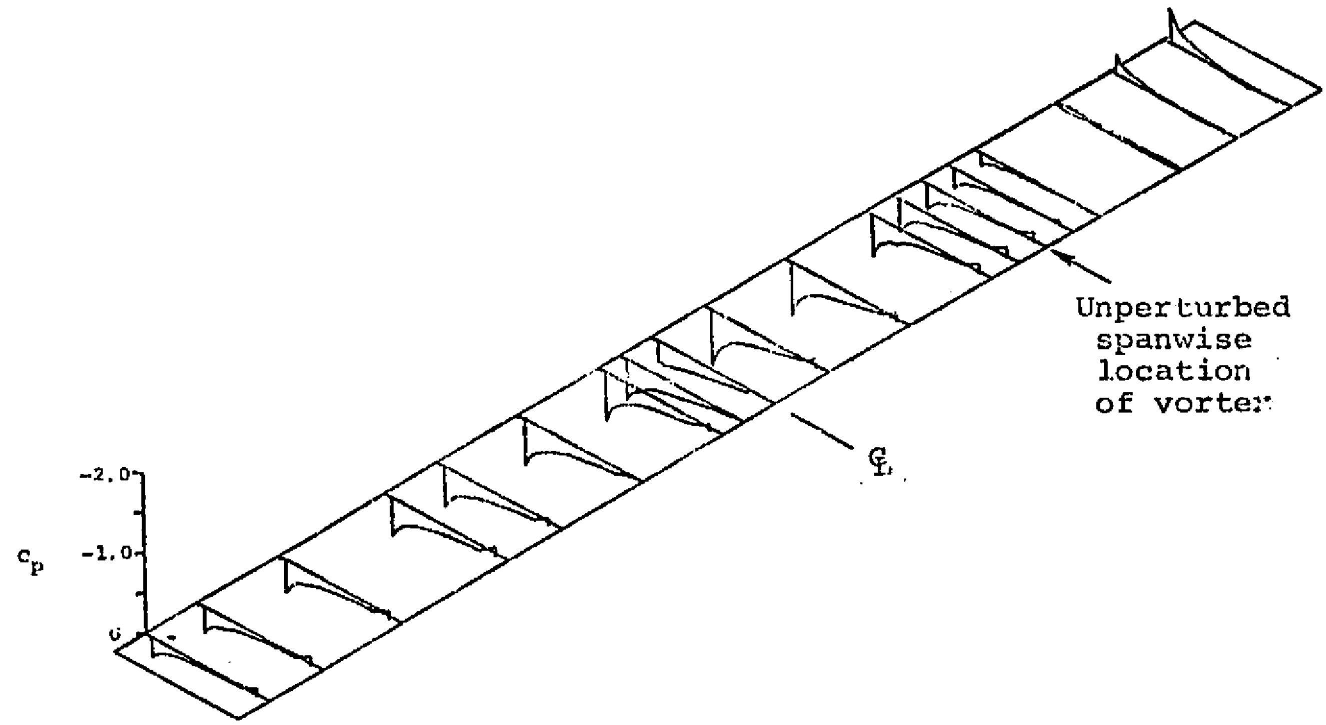
Figure 15.- Measured rolling moment and lift, $z_v/c = 0.05$.



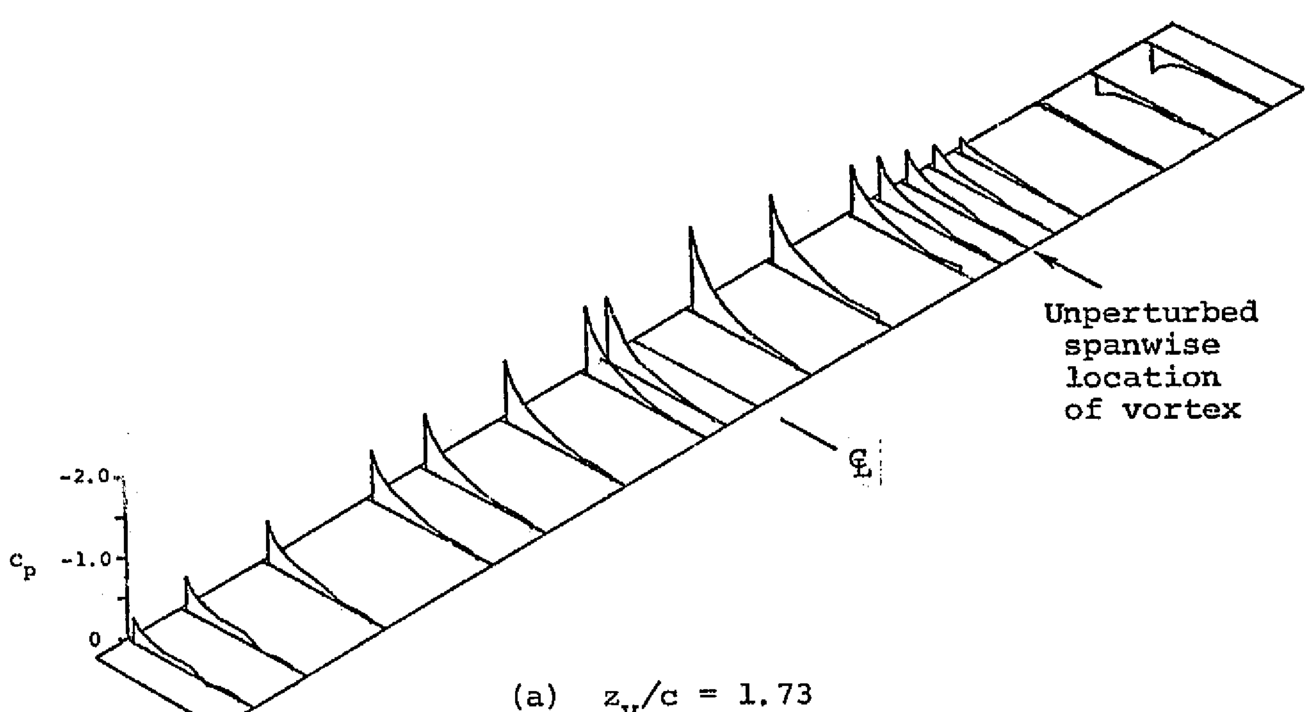
(b) Lift coefficient.

Figure 15.- Concluded.

RUN 66 - TOP

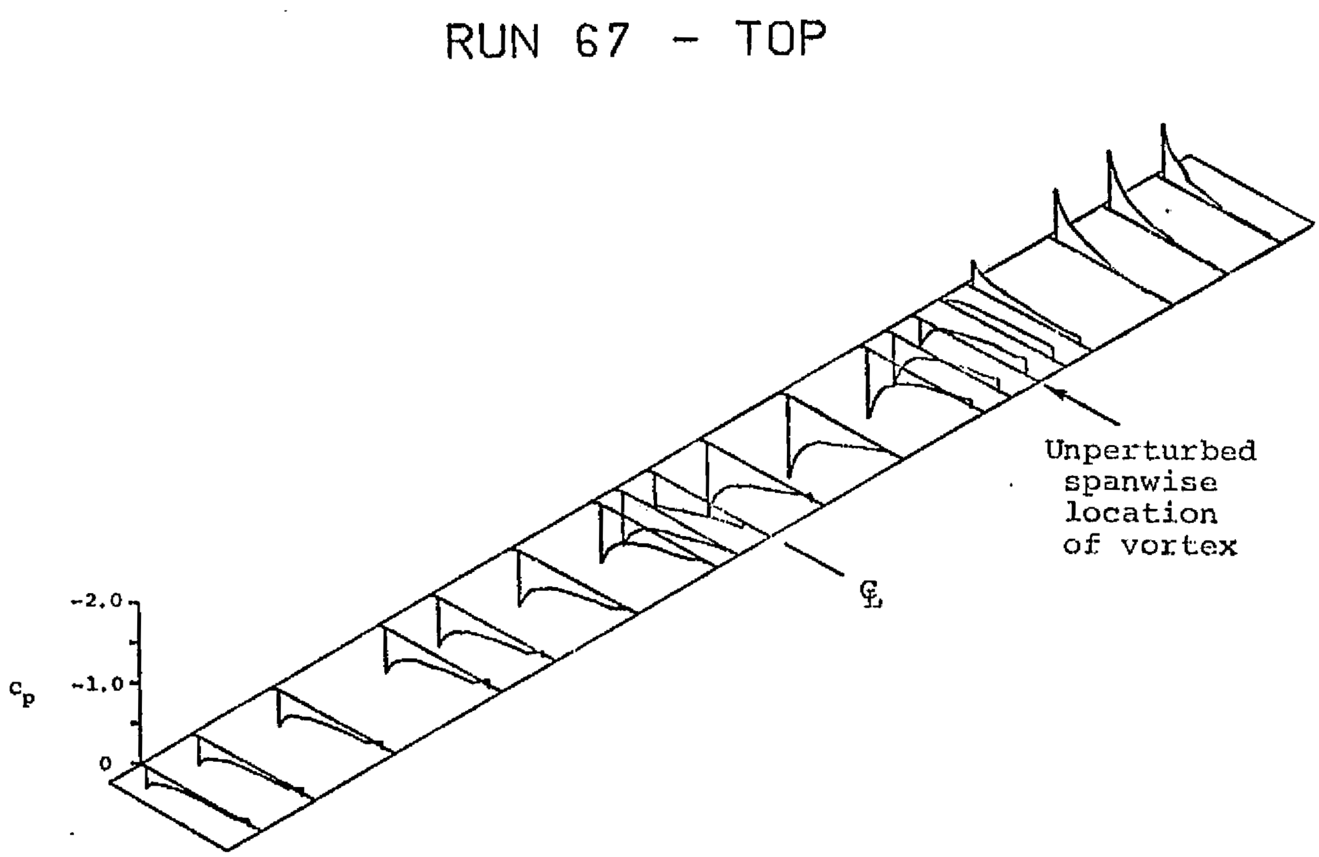


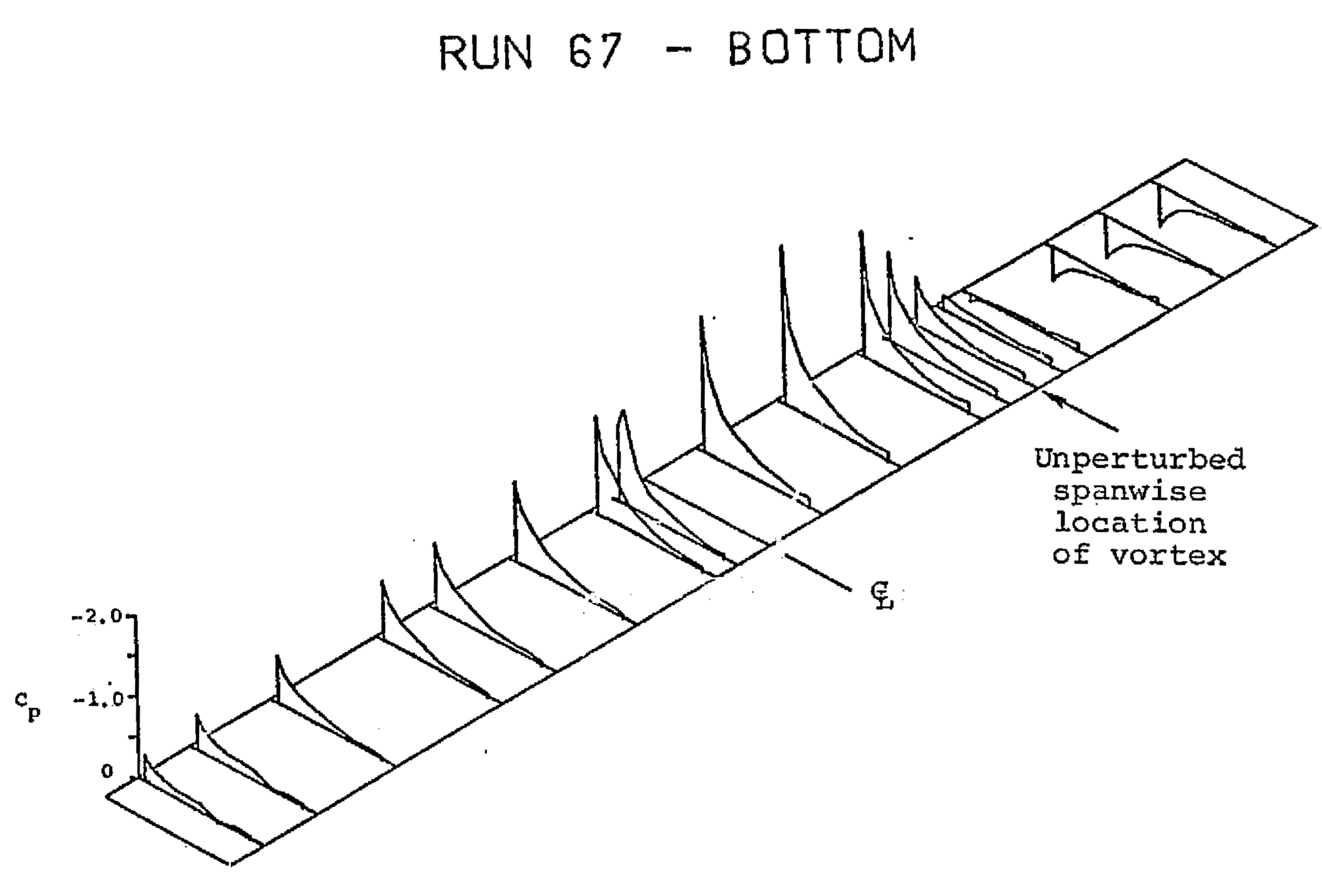
RUN 66 - BOTTOM



(a) $z_v/c = 1.73$

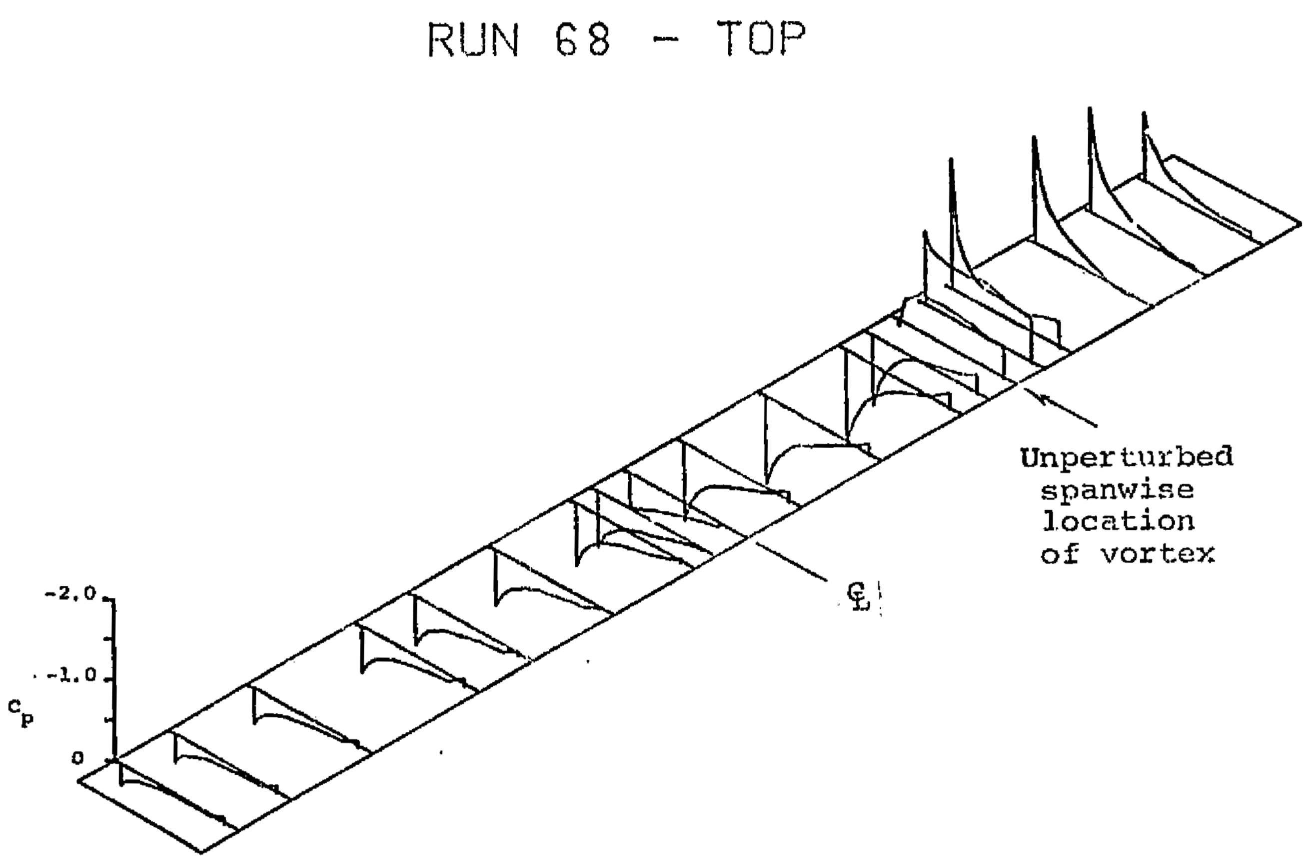
Figure 16.- Vortex-induced pressure distributions on following wing, $y_v/s = 0.5$.

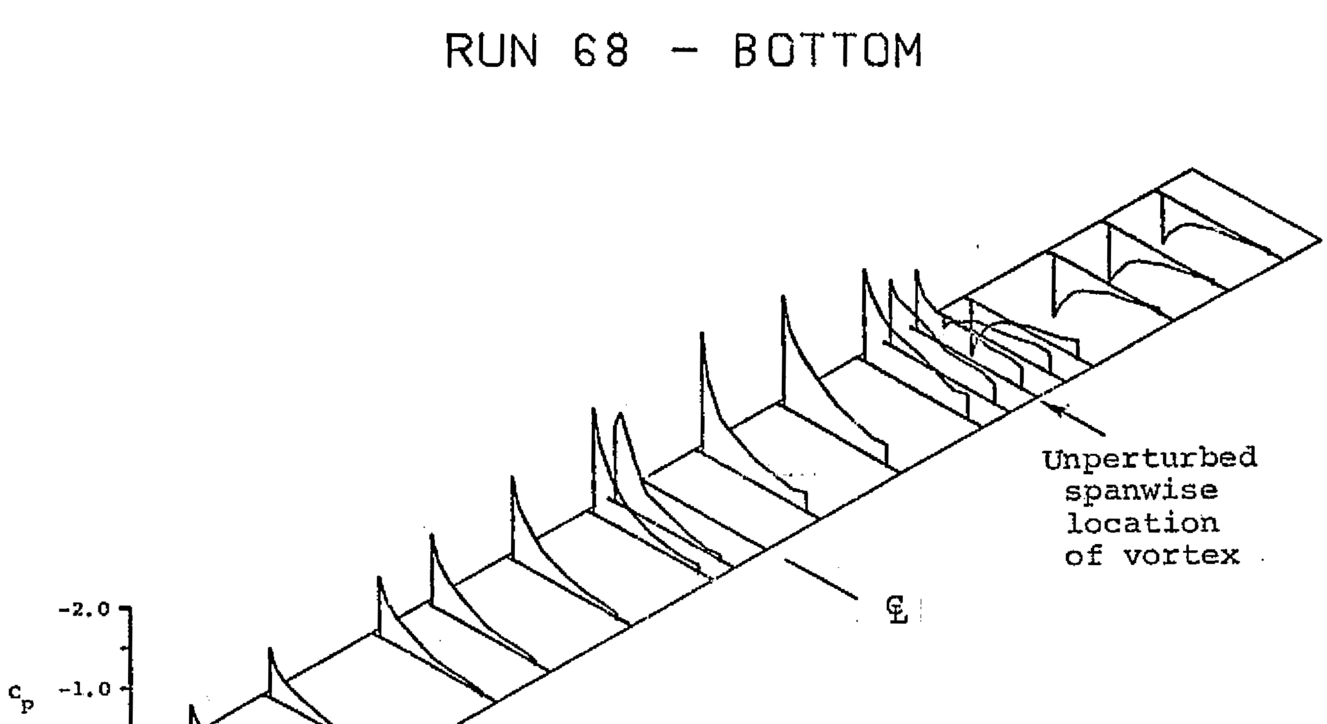




(b) $z_v/c = 0.73$.

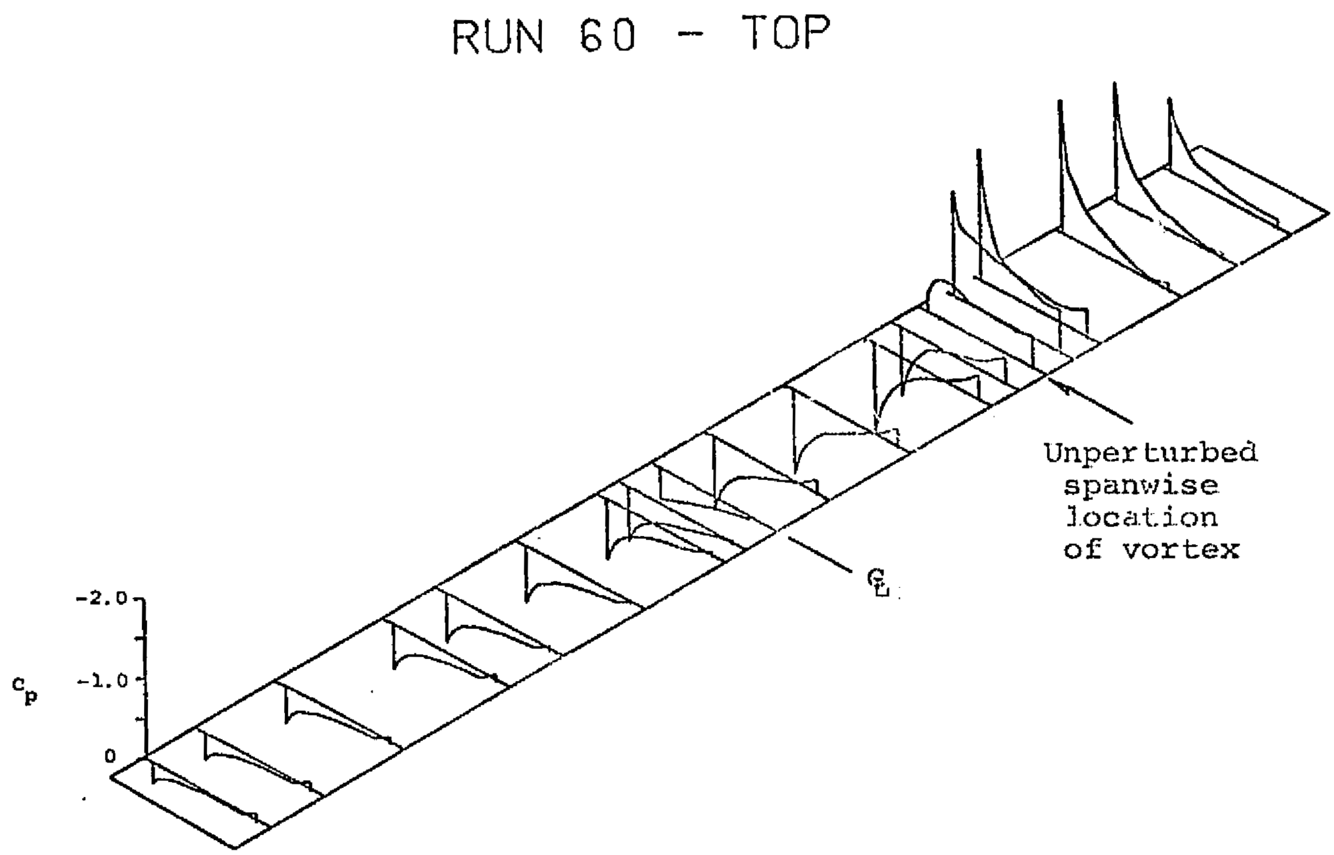
Figure 16.- Continued.

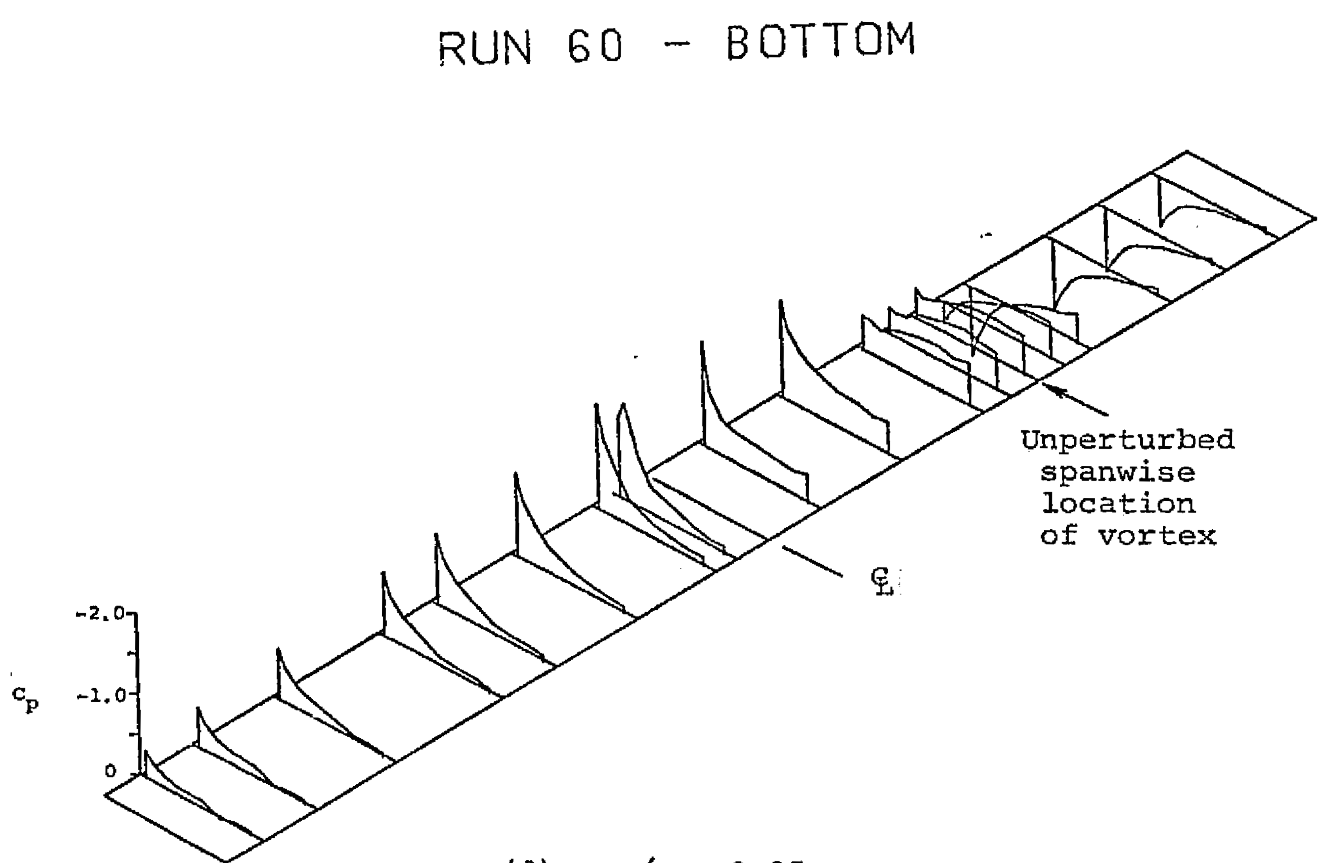




(c) $z_v/c = 0.23$.

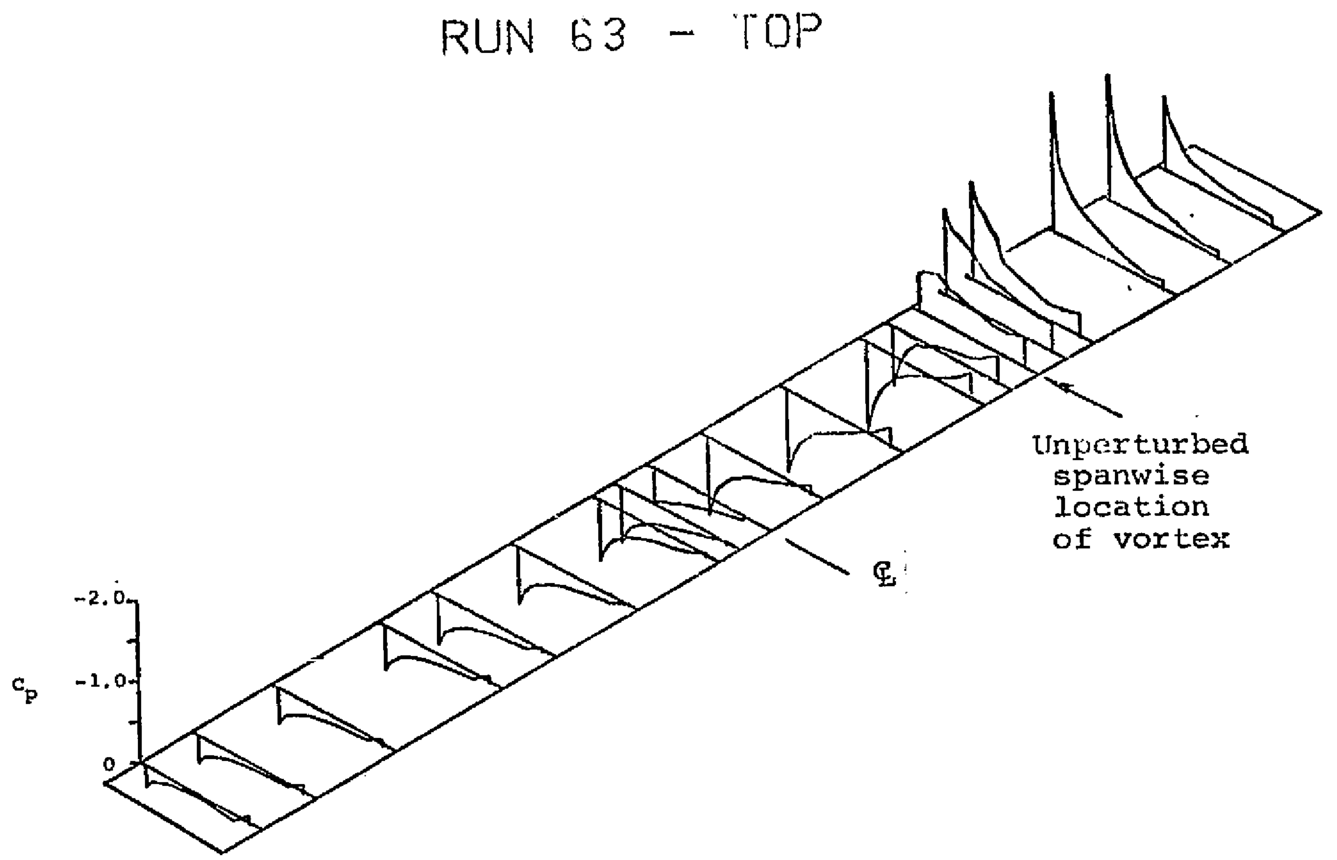
Figure 16.- Continued.

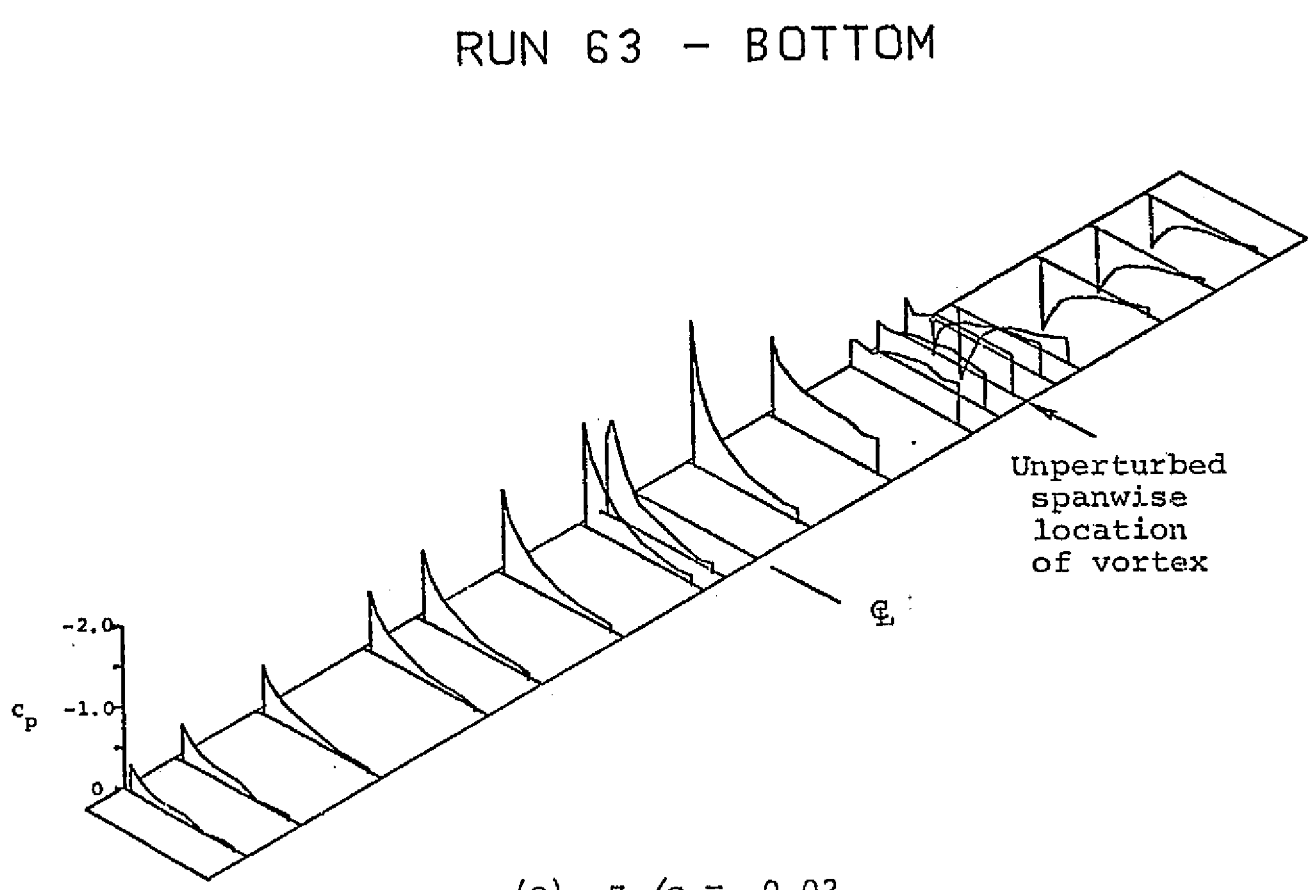




(d) $z_v/c = 0.05$.

Figure 16.- Continued.

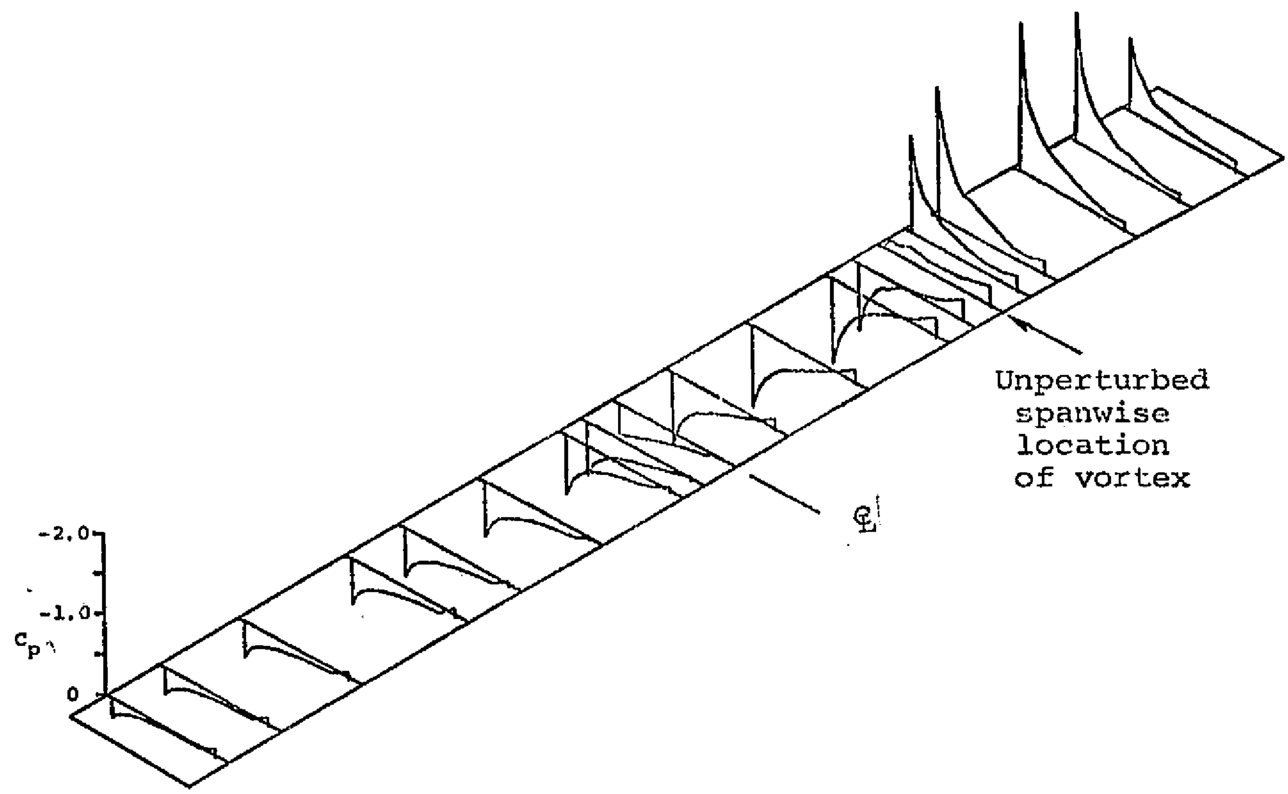




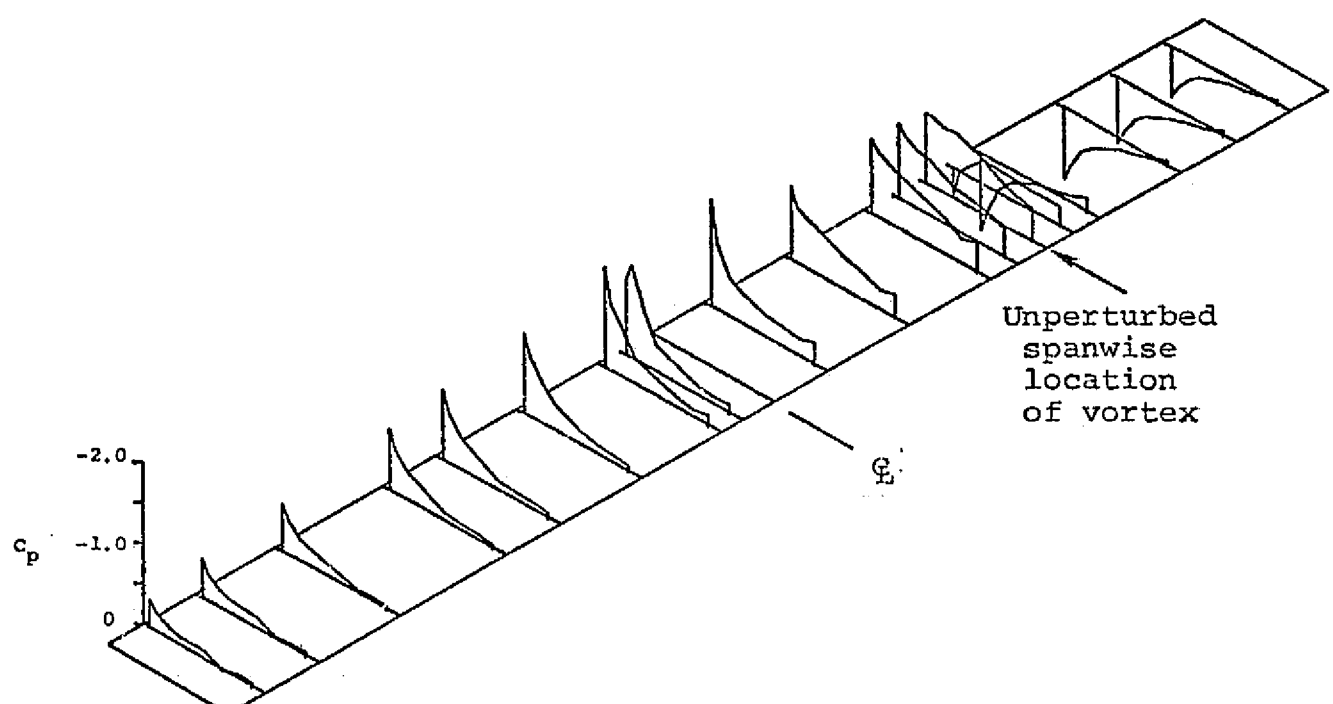
(e) $z_v/c = -0.02$.

Figure 16.- Continued.

RUN 58 - TOP

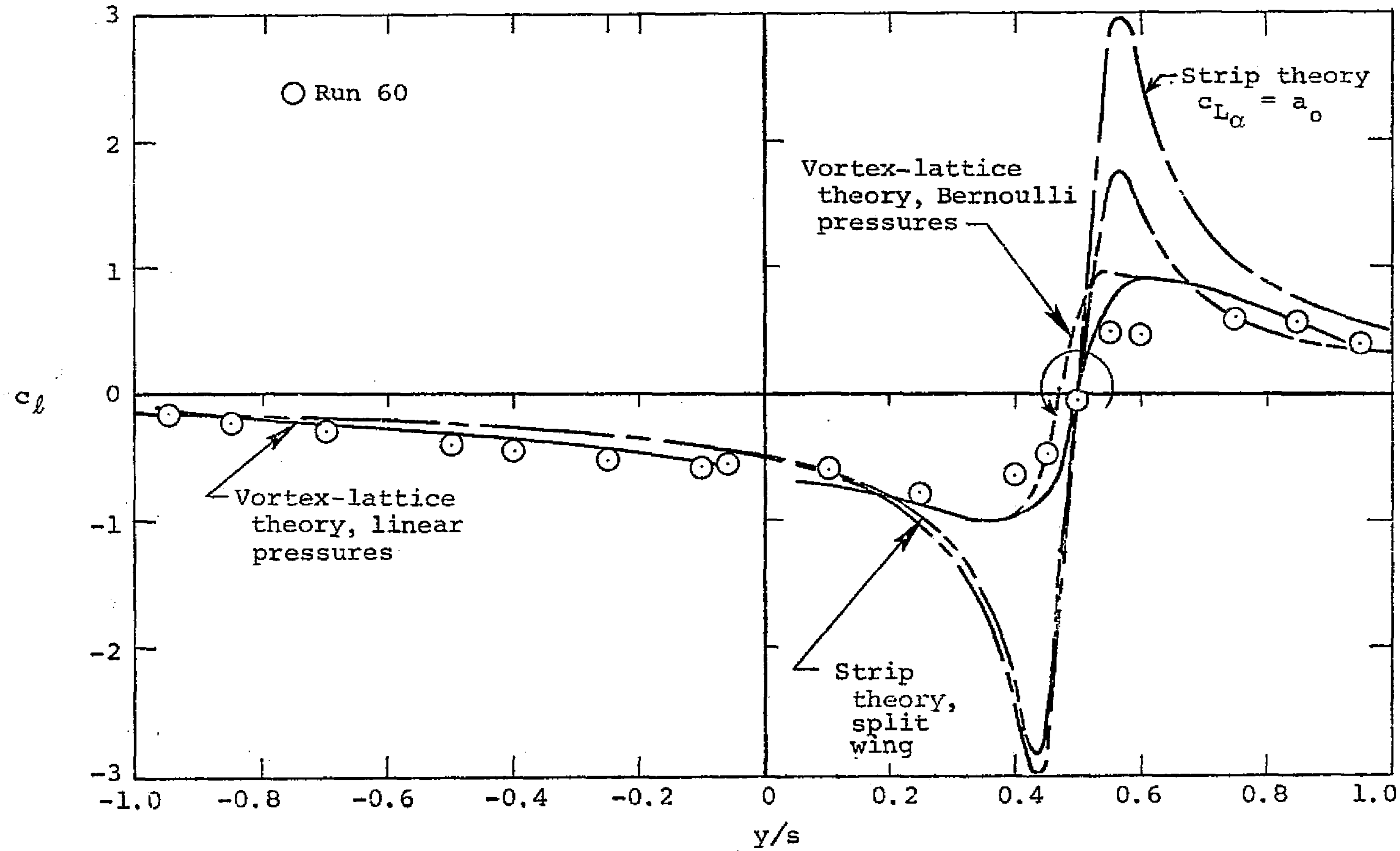


RUN 58 - BOTTOM



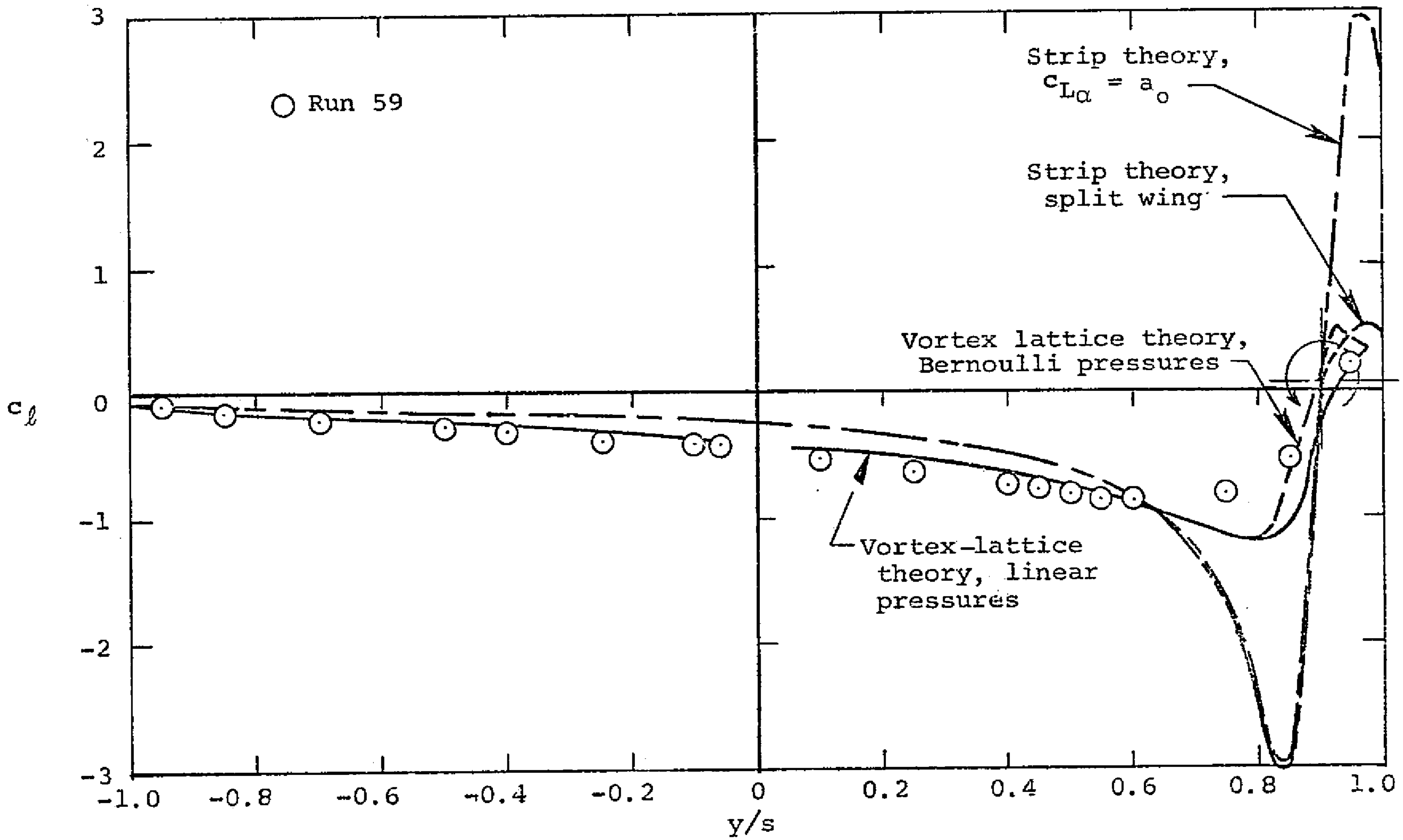
(f) $z_v/c = -0.18$.

Figure 16.- Concluded.



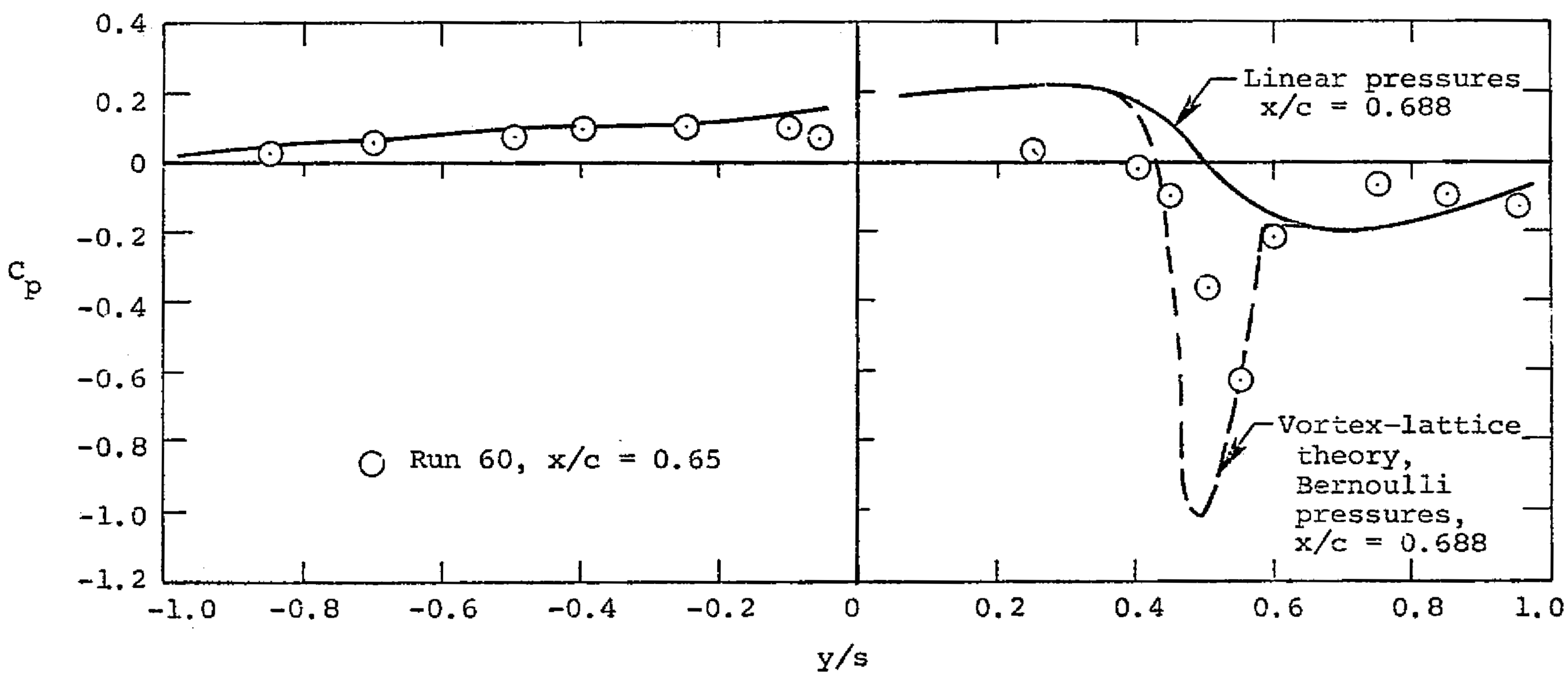
(a) $y_v/s = 0.5$.

Figure 17.- Comparison of predicted and measured span loadings. $z_v/c = 0.05$. Predictions use rectilinear, aged vortex, equation (12).



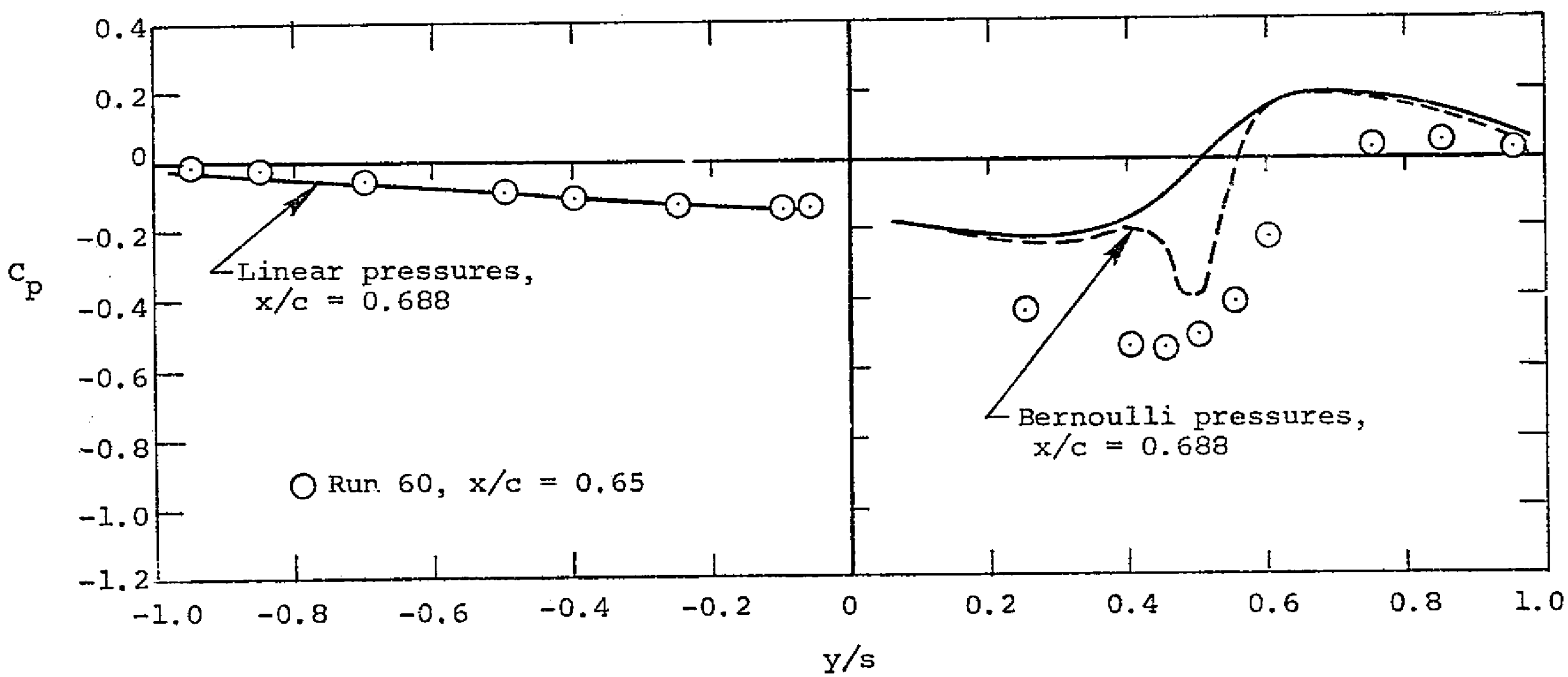
(b) $y_v/s = 0.9$.

Figure 17.- Concluded.



(a) Top wing surface.

Figure 18.- Pressure coefficients, $y_v/s = 0.5$, $z_v/c = 0.05$. Vortex-lattice predictions use rectilinear, aged vortex, equation (1).



(b) Bottom wing surface.

Figure 18.- Concluded.

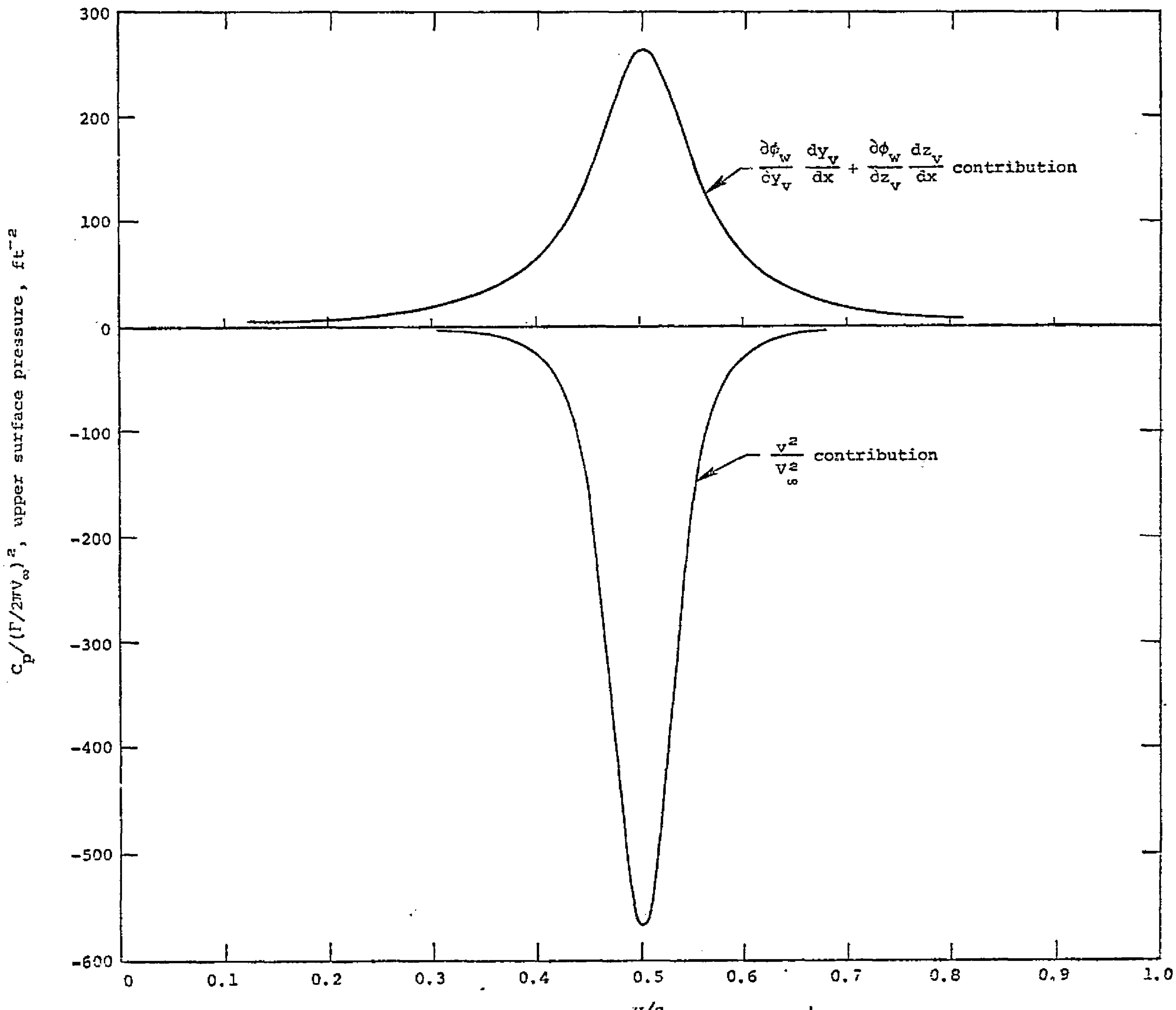


Figure 19 - Comparison of pressure contributions of vortex bending and nonlinear velocity terms from slender-body theory.

APPENDIX A

TABULATED EXPERIMENTAL DATA

All of the reduced data from this investigation are listed by run number* in Tables A.1 through A.5. In this appendix, the organization of these tables and the nomenclature used are explained.

Table A.1 contains the results from testing with the force model. The average values for C_L and C_ℓ shown are the averages using all the data taken at a particular test condition, after correction for the no-vortex loads $(\hat{C}_L, \hat{C}_\ell)$. The standard deviation for each quantity is also shown, as are the wing orientation (horizontal or vertical) and the angle of attack of the force model (zero except for the lift-curve runs).

The integrated average results from the pressure model are shown in Table A.2 (after correction for the no-vortex loads, run 69). The format of this computer printout is now described. J and Y are the spanwise row number and y/s location, respectively, of a chordwise row of pressure taps (as shown in figure 3).

LIFT is c_ℓ integrated from this row of taps using equations (3) and (4). ALPHASUBS is a fictional section angle of attack (in degrees) defined by the pressure difference between the upper and lower wing surfaces at $x/c = 0.05$ according to the relation

$$\text{ALPHASUBS} = 2.63\ (C_{p_\ell} - C_{p_u})\Big|_{x/c\ =\ 0.05} \qquad \text{(A.1)}$$

The constant in this relation was derived from two-dimensional wing section data (ref. 10). LIFT FROM ALPHASUBS is the product of ALPHASUBS and the two-dimensional section lift-curve slope for the NACA 0012 section (0.107/degree, ref. 10). This result, if appreciably different than c_ℓ is an indication that the section pressure distribution will not be well modeled by considerations involving only induced angle of attack (e.g., strip theory). CL LDNG EDGE is the contribution of equation (4) to LIFT. Table A.2 also contains integrated lift and rolling moment (C_L and C_ℓ) on the left and right wings, as well as the total values from equations (5) and (6). Finally, the overall integrated values from ALPHASUBS and the conditions in the tunnel free stream for the particular run are shown.

*Tables 2 and 3 are a guide to the test conditions for a given run number.

Table A.3 contains the average pressure coefficients (after correction for the no-vortex loads) at all of the pressure tap locations. I is the pressure tap number in a given chordwise row according to figure 3. X is the x/c coordinate of that tap, Y is y/s as before. A series of asterisks indicates a missing pressure tap. Table A.4 follows the same format, but the values listed are the standard deviations associated with the mean pressure coefficients in Table A.3.

Table A.5 contains the tare values for the pressure model in the absence of the vortex (run 69). Tables A.5(a), (b) and (c) follow the formats of Tables A.2, A.3, and A.4 respectively.

TABLE A.1-REDUCED DATA - FORCE MODEL

Run No.	Wing Orientation	α (degrees)	Average Over All Samples C_L	Average Over All Samples C_ℓ	Standard Deviation C_L	Standard Deviation C_ℓ
11	Vert.	0.	.233	-.0554	.011	.0028
12			.225	-.0558	.066	.0032
13			.240	-.0611	.011	.0032
14			.234	-.0607	.011	.0030
15			.233	-.0616	.012	.0027
16			-.035	-.1084	.013	.0020
17			-.036	-.1086	.011	.0020
18			.065	-.1071	.012	.0016
19			.067	-.1069	.011	.0021
20			.106	-.1005	.007	.0020
21			.450	.0510	.016	.0047
24	Horiz.		.151	-.0550	.018	.0040
25			-.253	-.0289	.023	.0042
26			-.318	-.0412	.022	.0041
27			.181	-.0708	.017	.0047
28			.206	-.0769	.013	.0040
29			-.310	-.0533	.021	.0048
30			-.288	-.0619	.020	.0038
31			.219	-.0757	.014	.0037
32			-.403	.0013	.023	.0041
33			-.108	-.1090	.013	.0036
34			-.119	-.1067	.015	.0039
35			-.404	.0418	.020	.0036
36			-.262	-.0655	.024	.0048
37			.234	-.0735	.015	.0037
38			.251	-.0716	.017	.0036
39			-.246	-.0637	.017	.0042
40			-.047	-.1155	.018	.0040
41			-.078	-.1117	.011	.0036
42			-.099	-.1100	.012	.0041
43			0.0	0.0	.019	.0039
44		1.23	.103	-.0022	.008	.0034
45		7.21	.571	.0052	.014	.0044
46		5.43	.427	.0030	.017	.0042
47		3.15	.240	.0023	.014	.0036

TABLE A.2.- INTEGRATED RESULTS - PRESSURE MODEL

RUN 50 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASJBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.381	3.711	.397	.093
2	-.850	.533	4.991	.534	.121
3	-.700	.642	5.729	.613	.139
4	-.500	.698	6.490	.694	.158
5	-.400	.712	6.723	.719	.163
6	-.250	.709	6.751	.722	.164
7	-.100	.682	6.257	.669	.152
8	-.060	.631	5.652	.605	.137
9	0.000	.671	*******	******	******
10	.100	.696	6.661	.713	.162
11	.250	.708	6.767	.724	.165
12	.400	.700	6.627	.709	.161
13	.450	.689	6.555	.701	.159
14	.500	.687	6.425	.638	.156
15	.550	.674	6.338	.678	.154
16	.600	.667	6.132	.656	.149
17	.750	.575	5.474	.586	.133
18	.850	.538	5.010	.536	.122
19	.950	.392	3.730	.396	.090

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.312	.0713
RIGHT WING	.311	-.0705
TOTAL	.622	.0008
FROM ALPHASUBS	.624	-.0002

QAVE = 30.244 PSF (STANDARD DEVIATION = .009 PSF)

TEMP = 23. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

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TABLE A.2.- CONTINUED

RUN 51 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.527	5.669	.607	.138
2	-.850	.678	6.547	.700	.154
3	-.700	.735	7.241	.775	.176
4	-.500	.856	8.325	.891	.202
5	-.400	.869	8.531	.913	.207
6	-.250	.830	7.677	.821	.187
7	-.100	.819	7.682	.822	.187
8	-.060	.780	7.108	.761	.173
9	0.000	.812	*******	******	******
10	.100	.831	7.914	.847	.192
11	.250	.870	8.023	.858	.195
12	.400	.861	8.169	.874	.199
13	.450	.857	8.172	.874	.199
14	.500	.357	8.210	.879	.200
15	.550	.853	8.245	.682	.200
16	.600	.858	8.281	.886	.201
17	.750	.795	8.294	.888	.202
18	.850	.702	7.124	.762	.173
19	.950	.522	5.083	.544	.124

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.382	.0887
RIGHT WING	.392	-.0911
TOTAL	.774	-.0025
FROM ALPHASUBS	.796	-.0044

QAVE = 30.134 PSF (STANDARD DEVIATION = .098 PSF)

TEMP = 23. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

TABLE A.2.- CONTINUED

RUN 53 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.151	-1.630	-.174	-.040
2	-.850	[illegible]	-2.211	-.237	-.054
3	-.700	-.317	-2.896	-.310	-.070
4	-.500	-.410	-3.540	-.379	-.085
5	-.400	-.461	-3.375	-.415	-.094
6	-.250	-.547	-4.584	-.490	-.111
7	-.100	-.607	-5.564	-.595	-.135
8	-.060	-.661	-6.782	-.726	-.165
9	0.000	-.728	*******	******	******
10	.100	-.769	-7.442	-.796	-.181
11	.250	-.873	-6.879	-.736	-.167
12	.400	-.770	-5.984	-.640	-.145
13	.450	-.556	-4.932	-.528	-.120
14	.500	.021	-1.929	-.206	-.047
15	.550	.491	2.764	.296	.067
16	.600	.398	5.533	.592	.135
17	.750	.463	5.236	.560	.127
18	.850	.471	5.085	.544	.124
19	.950	.366	3.687	.395	.090

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.206	-.0375
RIGHT WING	-.085	-.0154
TOTAL	-.291	-.0530
FROM ALPHASUBS	-.258	-.0603

QAVE = 30.015 PSF (STANDARD DEVIATION = .006 PSF)

TEMP = 28. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

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TABLE A.2.- CONTINUED

RUN 54 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.160	-1.519	-.173	-.039
2	-.850	-.237	-2.083	-.223	-.051
3	-.700	-.308	-2.800	-.300	-.068
4	-.500	-.391	-3.329	-.356	-.081
5	-.400	-.446	-3.825	-.409	-.092
6	-.250	-.515	-4.247	-.454	-.103
7	-.100	-.563	-5.179	-.554	-.126
8	-.060	-.595	-5.817	-.622	-.141
9	0.000	-.661	*******	******	******
10	.100	-.701	-6.952	-.744	-.169
11	.250	-.750	-7.507	-.803	-.183
12	.400	-.558	-6.080	-.651	-.148
13	.450	-.381	-4.393	-.470	-.107
14	.500	-.165	-2.475	-.265	-.060
15	.550	-.002	-.455	-.049	-.011
16	.600	.089	1.024	.110	.025
17	.750	.237	2.626	.281	.064
18	.650	.295	3.177	.340	.077
19	.950	.270	3.152	.327	.074

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.195	-.0381
RIGHT WING	-.114	.0000
TOTAL	-.309	-.0381
FROM ALPHASUBS	-.309	-.0363

QAVE = 29.772 PSF (STANDARD DEVIATION = .016 PSF)

TEMP = 28. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

TABLE A.2.- CONTINUED

RUN 56 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.161	-1.580	-.169	-.038
2	-.850	-.245	-2.225	-.238	-.054
3	-.700	-.322	-2.808	-.309	-.070
4	-.500	-.407	-3.575	-.383	-.087
5	-.400	-.466	-3.999	-.428	-.097
6	-.250	-.538	-4.477	-.479	-.109
7	-.100	-.574	-5.195	-.556	-.126
8	-.060	-.542	-3.910	-.418	-.095
9	0.000	-.615	*******	******	******
10	.100	-.659	-5.358	-.573	-.130
11	.250	-.613	-5.590	-.598	-.136
12	.400	-.590	-3.793	-.406	-.092
13	.450	-.289	-2.367	-.253	-.058
14	.500	.350	2.365	.253	.057
15	.550	.478	5.684	.608	.138
16	.600	.517	7.310	.782	.178
17	.750	.589	6.329	.677	.154
18	.650	.563	5.878	.629	.143
19	.950	.406	3.872	.414	.094

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.200	-.0395
RIGHT WING	-.027	-.0290
TOTAL	-.227	-.0685
FROM ALPHASUBS	-.154	-.0787

QAVE = 29.601 PSF (STANDARD DEVIATION = .048 PSF)

TEMP = 36. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

TABLE A.2.- CONTINUED

RUN 57 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LDNG EDGE
1	-.950	-.157	-1.600	-.171	-.039
2	-.850	-.235	-2.167	-.232	-.053
3	-.700	-.305	-2.766	-.296	-.067
4	-.500	-.389	-3.379	-.362	-.082
5	-.400	-.446	-3.790	-.406	-.092
6	-.250	-.523	-4.432	-.474	-.108
7	-.100	-.560	-5.224	-.559	-.127
8	-.060	-.549	-4.370	-.468	-.106
9	0.000	-.596	*******	******	******
10	.100	-.625	-5.169	-.553	-.126
11	.250	-.784	-6.263	-.670	-.152
12	.400	-.731	-4.655	-.498	-.113
13	.450	-.591	-3.686	-.394	-.090
14	.500	-.288	-2.075	-.222	-.050
15	.550	.334	2.127	.228	.052
16	.600	.479	5.378	.575	.131
17	.750	.563	6.757	.723	.164
18	.850	.536	5.712	.611	.139
19	.950	.409	4.001	.428	.097

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.193	-.0379
RIGHT WING	-.062	-.0196
TOTAL	-.255	-.0575
FROM ALPHASUBS	-.193	-.0674

QAVE = 29.932 PSF (STANDARD DEVIATION = .039 PSF)

TEMP = 36. DEG. CENT. BARO. PRESSURE = 29.92 IN. HG.

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TABLE A.2.- CONTINUED

RUN 58 SECTION COEFFICIENTS

J	Y	LIFT	ALPHA SUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.152	-1.540	-.165	-.037
2	-.850	-.234	-2.134	-.228	-.052
3	-.700	-.303	-2.706	-.290	-.066
4	-.500	-.392	-3.431	-.367	-.083
5	-.400	-.449	-3.809	-.408	-.093
6	-.250	-.521	-4.364	-.467	-.106
7	-.100	-.569	-5.127	-.549	-.125
8	-.060	-.553	-4.126	-.442	-.100
9	0.000	-.608	*******	******	******
10	.100	-.640	-5.806	-.621	-.141
11	.250	-.709	-4.969	-.532	-.121
12	.400	-.732	-5.165	-.553	-.126
13	.450	-.644	-4.564	-.488	-.111
14	.500	-.494	-2.214	-.237	-.054
15	.550	.159	4.006	.429	.097
16	.600	.593	6.696	.716	.163
17	.750	.674	7.051	.754	.171
18	.850	.607	6.257	.669	.152
19	.950	.427	3.975	.425	.097

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.193	-.0378
RIGHT WING	-.051	-.0236
TOTAL	-.245	-.0615
FROM ALPHASUBS	-.174	-.0724

QAVE = 30.018 PSF (STANDARD DEVIATION = .007 PSF)

TEMP = 30. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

TABLE A.2.- CONTINUED

RUN 59 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.110	-1.142	-.122	-.028
2	-.850	-.169	-1.634	-.175	-.040
3	-.700	-.225	-2.051	-.219	-.050
4	-.500	-.284	-2.506	-.268	-.061
5	-.400	-.318	-2.809	-.301	-.068
6	-.250	-.376	-3.218	-.344	-.078
7	-.100	-.415	-3.865	-.414	-.094
8	-.060	-.423	-3.551	-.380	-.085
9	0.000	-.497	*******	******	******
10	.100	-.542	-4.959	-.531	-.121
11	.250	-.645	-5.565	-.595	-.135
12	.400	-.732	-6.904	-.739	-.168
13	.450	-.769	-7.613	-.815	-.185
14	.500	-.815	-8.172	-.874	-.199
15	.550	-.846	-8.100	-.867	-.197
16	.600	-.857	-6.701	-.717	-.163
17	.750	-.822	-4.595	-.492	-.112
18	.850	-.536	-3.138	-.336	-.075
19	.950	.217	1.979	.212	.048

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.142	-.0275
RIGHT WING	-.305	.0699
TOTAL	-.446	.0424
FROM ALPHASUBS	-.402	.0295

QAVE = 30.127 PSF (STANDARD DEVIATION = .006 PSF)

TEMP = 30. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

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TABLE A.2.- CONTINUED

RUN 60 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.155	-1.563	-.167	-.038
2	-.850	-.237	-2.172	-.232	-.053
3	-.700	-.310	-2.818	-.301	-.069
4	-.500	-.401	-3.519	-.377	-.086
5	-.400	-.455	-3.860	-.413	-.094
6	-.250	-.532	-4.518	-.483	-.110
7	-.100	-.581	-5.362	-.574	-.130
8	-.060	-.561	-4.300	-.460	-.105
9	0.000	-.624	*******	******	******
10	.100	-.661	-5.714	-.611	-.139
11	.250	-.797	-5.798	-.620	-.141
12	.400	-.645	-3.959	-.424	-.095
13	.450	-.484	-3.033	-.325	-.074
14	.500	-.039	-.421	-.045	-.010
15	.550	.477	4.084	.437	.099
16	.600	.462	6.438	.689	.157
17	.750	.579	6.539	.700	.159
18	.850	.557	5.908	.632	.144
19	.950	.412	4.021	.430	.098

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.197	-.0385
RIGHT WING	-.048	-.0240
TOTAL	-.245	-.0625
FROM ALPHASUBS	-.177	-.0736

QAVE = 30.222 PSF (STANDARD DEVIATION = .008 PSF)

TEMP = 31. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

TABLE A.2.- CONTINUED

RUN 61 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.197	-2.032	-.217	-.049
2	-.850	-.306	-2.775	-.297	-.067
3	-.700	-.407	-3.613	-.387	-.088
4	-.500	-.520	-4.540	-.486	-.110
5	-.400	-.578	-5.059	-.541	-.123
6	-.250	-.639	-5.792	-.620	-.141
7	-.100	-.549	-4.335	-.464	-.105
8	-.060	-.411	-2.110	-.226	-.051
9	0.000	-.464	*******	******	******
10	.100	-.528	-5.252	-.562	-.128
11	.250	.555	3.764	.403	.092
12	.400	.630	6.844	.732	.166
13	.450	.651	7.176	.768	.174
14	.500	.673	6.975	.746	.170
15	.550	.686	7.114	.761	.173
16	.600	.696	6.859	.734	.167
17	.750	.595	5.325	.570	.129
18	.850	.491	4.405	.471	.107
19	.950	.337	3.031	.324	.074

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.229	-.0487
RIGHT WING	.187	-.0633
TOTAL	-.041	-.1119
FROM ALPHASUBS	-.026	-.1103

QAVE = 30.101 PSF (STANDARD DEVIATION = .011 PSF)

TEMP = 31. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

TABLE A.2.- CONTINUED

RUN 62 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.424	-4.138	-.443	-.101
2	-.850	-.627	-5.989	-.641	-.146
3	-.700	-.776	-5.910	-.632	-.144
4	-.500	.380	1.363	.199	.045
5	-.400	.577	5.986	.641	.146
6	-.250	.668	6.948	.743	.169
7	-.100	.698	6.701	.717	.163
8	-.060	.674	6.163	.659	.150
9	0.000	.670	*******	******	******
10	.100	.667	6.328	.677	.154
11	.250	.606	5.207	.557	.127
12	.400	.534	4.464	.478	.109
13	.450	.514	4.345	.465	.106
14	.500	.495	4.220	.452	.103
15	.550	.468	4.039	.432	.098
16	.600	.430	3.801	.407	.092
17	.750	.359	3.067	.328	.075
18	.850	.297	2.625	.281	.064
19	.950	.193	1.860	.199	.045

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.052	-.0252
RIGHT WING	.235	-.0472
TOTAL	.286	-.0725
FROM ALPHASUBS	.280	-.0672

QAVE = 29.998 PSF (STANDARD DEVIATION = .008 PSF)

TEMP = 31. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

TABLE A.2.- CONTINUED

RUN 63 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.167	-1.560	-.157	-.038
2	-.850	-.232	-2.109	-.226	-.051
3	-.700	-.307	-2.740	-.293	-.067
4	-.500	-.391	-3.401	-.364	-.083
5	-.400	-.452	-3.885	-.416	-.094
6	-.250	-.531	-4.523	-.484	-.110
7	-.100	-.589	-5.324	-.570	-.129
8	-.060	-.565	-4.251	-.455	-.103
9	0.000	-.662	*******	******	******
10	.100	-.721	-7.148	-.765	-.174
11	.250	-.771	-5.195	-.556	-.126
12	.400	-.596	-3.758	-.402	-.091
13	.450	-.452	-2.959	-.317	-.072
14	.500	-.049	-.146	-.016	-.004
15	.550	.329	3.746	.401	.091
16	.600	.527	5.450	.583	.133
17	.750	.623	6.766	.724	.165
18	.850	.585	6.166	.660	.150
19	.950	.422	4.034	.432	.098

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.197	-.0383
RIGHT WING	-.043	-.0264
TOTAL	-.240	-.0647
FROM ALPHASUBS	-.184	-.0729

QAVE = 30.166 PSF (STANDARD DEVIATION = .005 PSF)

TEMP = 29. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

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TABLE A.2.- CONTINUED

RUN 64 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.240	-2.448	-.262	-.060
2	-.850	-.378	-3.439	-.368	-.084
3	-.700	-.513	-4.479	-.479	-.109
4	-.500	-.646	-6.058	-.646	-.147
5	-.400	-.725	-7.198	-.770	-.175
6	-.250	-.765	-7.415	-.793	-.180
7	-.100	-.608	-6.043	-.647	-.147
8	-.060	-.368	-3.513	-.376	-.085
9	0.000	.172	*******	******	******
10	.100	.496	5.176	.554	.126
11	.250	.654	6.910	.739	.168
12	.400	.689	6.938	.742	.169
13	.450	.673	6.480	.693	.158
14	.500	.663	6.246	.668	.152
15	.550	.632	5.743	.614	.140
16	.600	.612	5.377	.575	.131
17	.750	.505	4.330	.463	.105
18	.850	.413	3.670	.393	.089
19	.950	.272	2.500	.267	.061

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.264	-.0601
RIGHT WING	.261	-.0615
TOTAL	-.003	-.1215
FROM ALPHASUBS	.001	-.1211

QAVE = 30.104 PSF (STANDARD DEVIATION = .008 PSF)

TEMP = 27. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

TABLE A.2.- CONTINUED

RUN 55 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.217	-2.244	-.240	-.055
2	-.850	-.345	-3.156	-.338	-.077
3	-.700	-.458	-4.135	-.442	-.101
4	-.500	-.594	-5.203	-.557	-.127
5	-.400	-.656	-6.100	-.653	-.145
6	-.250	-.729	-7.026	-.752	-.171
7	-.100	-.557	-4.972	-.532	-.121
8	-.060	-.437	-2.352	-.252	-.057
9	0.000	-.174	*******	******	******
10	.100	-.215	-1.419	-.152	-.035
11	.250	.577	6.827	.731	.166
12	.400	.646	6.755	.723	.164
13	.450	.671	6.984	.747	.170
14	.500	.664	6.906	.739	.168
15	.550	.605	6.405	.685	.155
16	.650	.649	6.027	.644	.146
17	.750	.536	4.742	.507	.115
18	.850	.443	3.951	.423	.095
19	.950	.295	2.674	.286	.065

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.253	-.0553
RIGHT WING	.214	-.0607
TOTAL	-.039	-.1161
FROM ALPHASUBS	-.015	-.1167

QAVE = 30.139 PSF (STANDARD DEVIATION = .075 PSF)

TEMP = 25. DEG. CENT. BARO. PRESSURE = 29.85 IN. HG.

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TABLE A.2.- CONTINUED

RUN 66 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.140	-1.441	-.154	-.035
2	-.850	-.218	-1.765	-.219	-.048
3	-.700	-.255	-2.471	-.264	-.060
4	-.550	-.322	-2.332	-.308	-.070
5	-.400	-.356	-3.118	-.334	-.075
6	-.250	-.396	-3.451	-.370	-.084
7	-.100	-.421	-3.745	-.421	-.091
8	-.050	-.355	-3.389	-.363	-.082
9	0.000	-.438	*******	******	******
10	.100	-.471	-4.041	-.436	-.110
11	.250	-.431	-3.871	-.414	-.094
12	.400	-.377	-2.991	-.320	-.073
13	.450	-.223	-2.478	-.265	-.060
14	.500	-.196	-1.986	-.213	-.043
15	.550	-.145	-1.417	-.152	-.034
16	.600	-.100	-.941	-.101	-.023
17	.750	.035	.123	.013	.003
18	.850	.112	1.195	.128	.029
19	.950	.149	2.022	.216	.049

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.253	-.0316
RIGHT WING	-.196	.0335
TOTAL	-.249	-.0233
FROM ALPHASUBS	-.242	-.0240

QAVE = 30.031 PSF (STANDARD DEVIATION = .034 PSF)

TEMP = 19. DEG. CENT. BARO. PRESSURE = 29.33 IN. HG.

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OF POOR QUALITY

TABLE A.2.- CONTINUED

RUN 67   SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.151	-1.592	-.156	-.033
2	-.850	-.227	-2.075	-.222	-.050
3	-.750	-.299	-2.738	-.293	-.057
4	-.550	-.335	-3.351	-.360	-.032
5	-.400	-.426	-3.715	-.398	-.090
6	-.250	-.509	-4.362	-.457	-.105
7	-.100	-.549	-5.053	-.541	-.123
8	-.050	-.533	-4.182	-.447	-.102
9	0.000	-.636	******	******	******
10	.100	-.693	-6.321	-.730	-.155
11	.250	-.752	-7.721	-.826	-.186
12	.400	-.557	-6.271	-.671	-.152
13	.450	-.375	-4.504	-.482	-.115
14	.500	-.133	-2.305	-.268	-.051
15	.550	.011	-.366	-.039	-.009
16	.600	.193	1.079	.215	.025
17	.750	.249	2.751	.294	.067
18	.850	.304	3.276	.351	.087
19	.950	.275	3.123	.334	.075

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.189	-.0370
RIGHT WING	-.112	-.0007
TOTAL	-.301	-.0377
FROM ALPHASUBS	-.3[illegible]	-.0352

QAVE = 30.132 PSF   (STANDARD DEVIATION = .005 PSF)

TEMP = 19. DEG. CENT.   BARO. PRESSURE = 29.83 IN. HG.

TABLE A.2.- CONTINUED

RUN 58 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	-.154	-1.592	-.173	-.039
2	-.850	-.232	-2.174	-.233	-.053
3	-.700	-.303	-2.791	-.299	-.068
4	-.500	-.396	-3.418	-.366	-.083
5	-.400	-.457	-3.895	-.417	-.095
6	-.250	-.524	-4.518	-.483	-.110
7	-.100	-.560	-5.401	-.578	-.131
8	-.060	-.368	-4.256	-.457	-.154
9	0.000	-.662	*******	******	******
10	.100	-.719	-6.427	-.688	-.155
11	.250	-.843	-6.403	-.685	-.155
12	.400	-.797	-5.961	-.638	-.145
13	.450	-.381	-4.406	-.471	-.107
14	.500	[illegible]	-2.158	-.231	-.052
15	.550	.491	2.750	.294	.057
16	.600	.434	5.967	.638	.145
17	.750	.474	5.397	.577	.131
18	.850	.484	5.252	.562	.128
19	.950	.375	3.830	.407	.092

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	-.197	-.0382
RIGHT WING	-.077	-.0167
TOTAL	-.274	.0549
FROM ALPHASUBS	-.225	-.0619

QAVE = 30.059 PSF (STANDARD DEVIATION = .065 PSF)

TEMP = 19. DEG. CENT. BARO. PRESSURE = 29.33 IN. HG.

TABLE A.2.- CONTINUED

RUN 70   SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.056	.659	.070	.015
2	-.850	.091	.936	.089	.020
3	-.700	.113	.966	.103	.023
4	-.500	.119	1.034	.111	.025
5	-.400	.124	1.156	.125	.028
6	-.250	.123	1.086	.116	.026
7	-.100	.123	1.208	.129	.029
8	-.050	.121	1.111	.119	.027
9	0.000	.122	*******	******	******
10	.100	.124	1.141	.122	.028
11	.250	.127	1.139	.122	.025
12	.400	.115	.894	.096	.022
13	.450	.118	1.122	.120	.027
14	.500	.119	1.080	.116	.026
15	.550	.113	1.026	.110	.025
16	.600	.115	1.022	.109	.025
17	.750	.107	1.134	.121	.023
18	.850	.095	.957	.102	.023
19	.950	.059	.582	.062	.014

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.054	.0122
RIGHT WING	.054	-.0121
TOTAL	.108	.0000
FROM ALPHASUBS	.107	-.0035

QAVE = 20.110 PSF   (STANDARD DEVIATION = .010 PSF)

TEMP = 25. DEG. CENT.   BARO. PRESSURE = 29.91 IN. HG.

TABLE A.2.- CONTINUED

RUN 71 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.269	2.727	.292	.066
2	-.850	.391	3.546	.379	.085
3	-.700	.483	3.975	.425	.097
4	-.500	.532	4.442	.475	.108
5	-.400	.535	4.521	.484	.110
6	-.250	.541	4.565	.488	.111
7	-.150	.545	4.593	.503	.114
8	-.050	.522	4.327	.516	.117
9	0.000	.536	*******	******	******
10	.100	.544	4.863	.520	.118
11	.250	.545	4.485	.480	.109
12	.400	.523	4.329	.463	.105
13	.450	.525	4.395	.470	.107
14	.500	.524	4.500	.481	.109
15	.550	.514	4.516	.483	.110
16	.600	.503	4.293	.459	.104
17	.750	.453	3.927	.420	.095
18	.850	.390	3.509	.375	.085
19	.950	.273	2.598	.278	.063

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.237	.0534
RIGHT WING	.237	-.0531
TOTAL	.474	.0002
FROM ALPHASUBS	.438	.0000

QAVE = 30.409 PSF (STANDARD DEVIATION = .009 PSF)

TEMP = 23. DEG. CENT. BARO. PRESSURE = 29.91 IN. HG.

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TABLE A.2.- CONTINUED

RUN 72 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.412	4.106	.439	.130
2	-.850	.567	5.376	.629	.143
3	-.750	.682	6.295	.674	.153
4	-.500	.759	7.152	.765	.174
5	-.400	.751	7.165	.767	.174
6	-.250	.722	6.454	.691	.157
7	-.100	.712	6.467	.692	.157
8	-.065	.541	5.979	.640	.145
9	0.000	.722	******	******	******
10	.100	.739	6.767	.724	.165
11	.250	.769	7.515	.804	.183
12	.400	.746	7.199	.763	.173
13	.450	.733	6.935	.742	.169
14	.500	.735	7.030	.752	.171
15	.550	.726	6.929	.741	.168
16	.650	.726	6.919	.740	.168
17	.750	.640	6.022	.644	.146
18	.850	.579	5.553	.595	.135
19	.950	.421	3.942	.422	.095

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.330	.0760
RIGHT WING	.335	-.0763
TOTAL	.655	-.0003
FROM ALPHASUBS	.671	-.0001

QAVE = 30.313 PSF (STANDARD DEVIATION = .007 PSF)

TEMP = 23. DEG. CENT. BARO. PRESSURE = 29.91 IN. HG.

TABLE A.2.- CONTINUED

RUN 73 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.467	4.335	.517	.113
2	-.850	.634	6.210	.654	.151
3	-.700	.725	6.555	.702	.157
4	-.500	.619	8.070	.863	.195
5	-.400	.821	8.213	.879	.200
6	-.250	.773	6.931	.742	.169
7	-.100	.772	7.118	.752	.173
8	-.050	.746	6.520	.798	.151
9	0.000	.777	*******	******	******
10	.100	.795	7.398	.792	.180
11	.250	.820	7.733	.853	.139
12	.400	.811	7.355	.842	.191
13	.450	.845	7.753	.839	.187
14	.500	.803	7.711	.825	.188
15	.550	.797	7.834	.838	.190
16	.600	.763	7.557	.809	.184
17	.750	.720	7.046	.754	.171
18	.850	.645	6.457	.691	.157
19	.950	.470	4.443	.475	.198

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.357	.0825
RIGHT WING	.366	-.0841
TOTAL	.723	-.0016
FROM ALPHASUBS	.736	-.0024

QAVE = 30.241 PSF (STANDARD DEVIATION = .009 PSF)

TEMP = 23. DEG. CENT. BARO. PRESSURE = 29.91 IN. HG.

TABLE A.2.- CONCLUDED

RUN 74 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.595	5.543	.593	.135
2	-.850	.675	6.518	.708	.161
3	-.750	.767	6.935	.742	.169
4	-.550	.831	7.712	.825	.188
5	-.400	.850	8.134	.870	.193
6	-.250	.849	7.995	.892	.182
7	-.150	.829	7.623	.816	.185
8	-.050	.750	7.355	.755	.172
9	0.000	.812	*******	******	******
10	.100	.831	7.737	.834	.190
11	.250	.852	7.677	.821	.187
12	.400	.855	8.137	.868	.197
13	.450	.853	8.117	.858	.197
14	.500	.852	8.087	.865	.197
15	.550	.847	8.127	.857	.197
16	.650	.849	8.147	.872	.195
17	.750	.774	8.115	.858	.197
18	.850	.731	7.469	.756	.172
19	.950	.513	4.881	.522	.119

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.376	.0377
RIGHT WING	.389	[illegible]
TOTAL	.764	-.0034
FROM ALPHASUBS	.773	-.0056

QAVE = 30.221 PSF (STANDARD DEVIATION = .038 PSF)

TEMP = 22. DEG. CENT. BARO. PRESSURE = 29.72 IN. HG.

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TABLE A.3.- SURFACE PRESSURE COEFFICIENTS

RUN 50 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.768	-1.025	******	-1.477	******	-1.471	-1.673	-2.614	-.172
2	.025	-1.165	-1.516	-1.984	-1.881	-1.855	-1.928	-2.117	-2.004	-.552
3	.050	-.769	-1.109	-1.316	-1.572	-1.669	-1.652	-1.423	-1.131	-.526
4	.100	-.532	-.688	-.879	-.877	-.837	-.918	-.879	-.772	-.501
5	.150	-.414	-.557	-.664	-.684	-.745	-.699	-.685	-.611	-.451
6	.200	-.280	-.430	-.502	-.541	-.563	-.558	-.546	-.480	-.395
7	.250	-.223	-.370	-.428	-.459	-.468	-.466	-.457	-.410	-.352
8	.300	-.167	-.273	-.340	-.366	-.365	-.376	-.355	-.326	******
9	.400	-.137	-.196	-.250	-.258	-.260	-.274	-.249	-.244	******
10	.500	-.128	-.164	-.206	-.222	-.224	-.219	-.198	-.190	-.197
11	.650	******	-.088	-.111	-.129	-.126	-.112	-.086	-.111	-.125
12	.780	-.045	-.023	-.034	-.042	-.041	-.040	-.034	-.061	-.084
13	.900	-.092	-.044	-.060	-.034	-.073	-.045	-.039	-.031	
14	.050	.643	.793	.864	.898	.889	.917	.958	1.020	
15	.100	.462	.616	.683	.724	.710	.726	.793	.780	
16	.200	.277	.398	.453	.491	.514	.509	.538	.598	
17	.300	.191	.297	.360	.376	.392	.396	.416	.413	
18	.500	.099	.171	.221	.235	.243	.237	.239	******	
19	.650	.076	.125	.160	.171	.173	.170	.164	.135	
20	.780	.003	.050	.089	.106	.102	.086	.062	-.114	
21	.900	-.027	-.002	.022	.041	.030	.019	-.022	-.018	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.399	-1.790	-1.800	******	-1.240	-1.174	-1.105	-1.001	-.912	-.438
2	.025	-2.052	-1.928	-2.024	-1.829	-1.964	-1.827	-1.887	-1.632	-1.529	-1.153
3	.050	-1.562	-1.665	-1.605	-1.595	-1.547	-1.516	-1.459	-1.254	-1.146	-.791
4	.100	-.880	-.848	-.833	-.836	-.887	-.854	-.877	-.842	-.769	-.495
5	.150	-.685	-.678	-.668	-.658	-.670	-.663	-.655	-.546	-.527	-.416
6	.200	-.456	-.546	-.554	-.537	-.551	******	-.509	-.463	-.392	-.321
7	.250	-.489	-.459	-.457	-.459	-.446	-.438	-.445	-.383	-.342	-.211
8	.300	-.354	-.394	-.396	-.384	-.377	-.371	-.372	-.340	-.287	******
9	.400	-.249	******	-.266	-.254	-.253	-.250	******	******	-.183	******
10	.500	-.201	******	-.224	******	******	-.208	******	-.197	-.168	-.117
11	.650	******	-.105	-.117	-.113	-.116	-.107	-.104	-.097	-.082	-.035
12	.780	-.054	-.061	-.065	-.060	-.054	-.045	-.059	-.045	-.047	-.039
13	.900	-.058	-.057	-.061	-.064	-.063	-.063	-.058	-.053	-.068	-.056
14	.050	.973	.910	.916	.899	.898	.896	.875	.819	.761	.617
15	.100	.777	.711	.703	.709	.718	.689	.692	.670	.627	.477
16	.200	.544	.510	.501	.492	.504	.497	.483	.435	.400	.237
17	.300	.400	.391	.383	.378	.379	.369	.352	.332	.285	.190
18	.500	.238	.232	.234	.237	.229	.227	.214	.195	.167	.095
19	.650	******	.177	.167	.165	.164	.162	.160	-.069	.118	.074
20	.780	.061	.084	.092	.089	.090	.088	.088	.062	.078	.027
21	.900	-.018	-.019	-.017	.022	.018	.023	.015	.005	.002	-.022

TABLE A.3.- CONTINUED

RUN 51 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-1.363	-1.982	******	-2.431	******	-2.502	-2.942	-4.266	-.149
2	.025	-1.598	-2.319	-2.988	-2.895	-2.895	-3.162	-2.886	-2.272	-.924
3	.050	-1.344	-1.552	-1.700	-2.095	-2.171	-1.843	-1.787	-1.511	-.840
4	.100	-.643	-.971	-1.133	-1.182	-1.205	-1.188	-1.169	-.993	-.701
5	.150	-.489	-.720	-.857	-.884	-.920	-.902	-.847	-.737	-.591
6	.200	-.383	-.563	-.666	-.694	-.715	-.706	-.659	-.575	-.497
7	.250	-.313	-.459	-.536	-.573	-.582	-.564	-.514	-.473	-.437
8	.300	-.242	-.346	-.417	-.450	-.454	-.442	-.388	-.363	******
9	.400	-.188	-.246	-.294	-.309	-.312	-.307	-.243	-.228	******
10	.500	-.170	-.139	-.223	-.239	-.239	-.215	-.160	-.147	-.214
11	.650	******	-.091	-.098	-.111	-.109	-.088	-.053	-.092	-.136
12	.780	-.078	-.015	-.014	-.018	-.026	-.024	-.090	-.108	-.118
13	.900	-.112	-.045	-.058	-.088	-.077	-.075	-.179	-.178	
14	.050	.813	.939	1.055	1.073	1.075	1.078	1.136	1.194	
15	.100	.600	.781	.853	.878	.885	.907	.974	.967	
16	.200	.364	.505	.590	.624	.645	.642	.671	.743	
17	.300	.250	.378	.447	.483	.481	.500	.518	.519	
18	.500	.130	.214	.267	.287	.288	.287	.294	******	
19	.650	.090	.147	.183	.194	.194	.189	.180	.152	
20	.780	.002	.055	.085	.093	.088	.077	.048	-.004	
21	.900	-.038	-.015	-.011	.005	-.006	-.027	-.065	-.080	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-2.502	-3.142	-2.881	******	-2.144	-1.975	-1.957	-1.848	-1.776	-.972
2	.025	-2.737	-2.958	-2.865	-2.714	-2.733	-2.767	-2.727	-2.339	-2.211	-1.581
3	.050	-1.867	-1.992	-2.025	-2.024	-2.051	-2.075	-2.100	-2.156	-1.775	-1.164
4	.100	-1.163	-1.201	-1.221	-1.195	-1.171	-1.165	-1.175	-1.057	-.961	-.711
5	.150	-.855	-.919	-.899	-.893	-.901	-.890	-.868	-.792	-.690	-.490
6	.200	-.548	-.708	-.702	-.694	-.713	******	-.670	-.611	-.536	-.370
7	.250	-.546	-.584	-.584	-.581	-.580	-.562	-.574	-.513	-.450	-.309
8	.300	-.391	-.492	-.490	-.481	-.476	-.471	-.468	-.425	-.369	******
9	.400	-.257	******	-.313	-.308	-.310	-.309	******	******	-.234	******
10	.500	-.153	******	-.252	******	******	-.242	******	-.224	-.198	-.162
11	.650	******	-.101	-.109	-.110	-.111	-.107	-.109	-.099	-.091	-.126
12	.780	-.093	-.049	-.045	-.047	-.038	-.026	-.043	-.032	-.035	-.113
13	.900	-.183	-.082	-.071	-.069	-.061	-.063	-.051	-.056	-.062	-.100
14	.050	1.145	1.069	1.084	1.085	1.073	1.062	1.051	1.000	.935	.770
15	.100	.946	.898	.865	.872	.884	.852	.864	.839	.776	.608
16	.200	.687	.652	.630	.631	.629	.630	.615	.565	.517	.375
17	.300	.510	.488	.485	.480	.483	.479	.464	.435	.374	.247
18	.500	.298	.294	.293	.295	.288	.285	.282	.251	.214	.125
19	.650	******	.207	.199	.198	.198	.195	.192	.094	.142	.087
20	.780	.049	.085	.097	.095	.096	.097	.098	.038	.078	.021
21	.900	-.064	-.045	-.042	-.000	-.004	.003	-.002	-.010	-.013	-.034

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TABLE A.3.- CONTINUED

RUN 53 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.047	-.037	******	-.304	******	-.616	-.734	-.780	.287
2	.025	.349	.460	.558	.705	.773	.883	1.003	.918	.398
3	.050	.249	.336	.451	.566	.598	.682	.776	.717	.416
4	.100	.141	.227	.308	.415	.451	.514	.571	.529	.391
5	.150	.106	.163	.228	.329	.353	.409	.446	.428	.356
6	.200	.073	.134	.195	.262	.292	.350	.371	.361	.324
7	.250	.050	.113	.156	.217	.257	.311	.316	.307	.291
8	.300	.036	.083	.128	.179	.207	.254	.270	.258	******
9	.400	.018	.057	.101	.145	.163	.189	.207	.197	******
10	.500	-.003	.034	.067	.104	.123	.154	.159	.160	.154
11	.650	******	.022	.047	.078	.089	.109	.114	.088	.087
12	.780	-.005	.016	.033	.060	.067	.082	.054	.031	.052
13	.900	-.094	-.100	-.081	-.089	-.046	-.012	-.039	-.021	
14	.050	-.372	-.505	-.651	-.782	-.877	-1.063	-1.341	-1.653	
15	.100	-.260	-.361	-.443	-.564	-.624	-.749	-.983	-1.119	
16	.200	-.172	-.237	-.296	-.379	-.428	-.520	-.585	-.561	
17	.300	-.124	-.184	-.223	-.298	-.330	-.350	-.389	-.398	
18	.500	-.129	-.156	-.133	-.127	-.146	-.188	-.186	******	
19	.650	-.010	-.032	-.065	-.101	-.111	-.131	-.115	-.136	
20	.780	-.063	-.061	-.070	-.085	-.101	-.110	-.071	-.071	
21	.900	-.048	-.053	-.054	-.054	-.072	-.083	-.079	-.081	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-2.173	-2.186	-2.055	******	-1.089	-.816	-1.335	-.902	-1.063	-.492
2	.025	1.217	1.243	1.265	1.054	.132	-1.085	-1.788	-1.658	-1.598	-1.215
3	.050	.999	1.088	1.132	.896	.017	-.921	-1.448	-1.243	-1.227	-.822
4	.100	.710	.825	.827	.558	-.299	-.736	-.703	-.874	-.742	-.539
5	.150	.567	.676	.660	.392	-.399	-.726	-.483	-.552	-.538	-.452
6	.200	.467	.562	.565	.270	-.464	******	-.340	-.423	-.402	-.328
7	.250	.393	.473	.418	.167	-.507	-.704	-.275	-.341	-.336	-.226
8	.300	.335	.399	.333	.130	-.536	-.633	-.203	-.285	-.276	******
9	.400	.246	******	.203	.007	-.516	-.640	******	******	-.158	******
10	.500	.178	******	.124	******	******	-.647	******	-.116	-.138	-.127
11	.650	******	.106	.036	-.088	-.447	-.648	-.180	-.021	-.054	-.094
12	.780	.013	.009	-.058	-.141	-.437	-.592	-.239	.020	-.020	-.083
13	.900	-.091	-.145	-.184	-.242	-.384	-.545	-.291	-.046	-.063	-.095
14	.050	-1.833	-1.529	-1.145	-.980	-.717	.130	.657	.749	.707	.581
15	.100	-1.202	-1.004	-.789	-.789	-.471	.009	.426	.545	.560	.443
16	.200	-.737	-.802	-.697	-.626	-.421	-.093	.159	.316	.331	.242
17	.300	-.514	-.645	-.614	-.531	-.356	-.156	.036	.212	.220	.139
18	.500	-.252	-.436	-.413	-.365	-.360	-.184	-.087	.078	.099	.050
19	.650	******	-.301	-.340	-.298	-.314	-.181	-.103	.039	.051	.027
20	.780	-.098	-.228	-.280	-.261	-.269	-.227	-.167	-.010	.009	-.009
21	.900	-.144	-.282	-.341	-.297	-.312	-.303	-.243	-.074	-.057	-.055

TABLE A.3.- CONTINUED

RUN 54 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.039	-.032	******	-.276	******	-.556	-.688	-.506	.252
2	.025	.342	.469	.555	.694	.743	.865	.944	.861	.358
3	.050	.254	.339	.450	.541	.581	.663	.716	.668	.393
4	.100	.141	.229	.295	.394	.433	.489	.527	.485	.366
5	.150	.105	.171	.228	.313	.346	.382	.417	.400	.323
6	.200	.076	.136	.179	.268	.283	.337	.345	.336	.295
7	.250	.053	.110	.157	.223	.240	.302	.304	.281	.269
8	.300	.036	.086	.117	.179	.205	.245	.250	.242	******
9	.400	.023	.058	.094	.142	.162	.184	.193	.190	******
10	.500	-.003	.035	.067	.106	.120	.152	.152	.152	.146
11	.650	******	.029	.045	.075	.091	.102	.110	.080	.086
12	.780	-.007	.015	.033	.061	.066	.080	.058	.030	.054
13	.900	-.095	-.100	-.081	-.091	-.049	-.010	-.038	-.008	
14	.050	-.361	-.454	-.616	-.725	-.874	-.953	-1.255	-1.546	
15	.100	-.279	-.358	-.454	-.527	-.613	-.723	-.852	-1.115	
16	.200	-.166	-.224	-.288	-.365	-.409	-.485	-.586	-.498	
17	.300	-.120	-.175	-.215	-.278	-.304	-.332	-.352	-.346	
18	.500	-.128	-.155	-.134	-.118	-.135	-.173	-.164	******	
19	.650	-.005	-.035	-.059	-.094	-.102	-.117	-.101	-.123	
20	.780	-.063	-.058	-.064	-.082	-.099	-.101	-.070	-.062	
21	.900	-.048	-.053	-.053	-.049	-.066	-.076	-.066	-.061	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.713	-1.812	-1.375	******	-.227	-.088	-.092	-.213	-.523	-.330
2	.025	1.136	1.134	1.039	.813	.465	.016	-.400	-.839	-.971	-.990
3	.050	.941	.974	.823	.606	.319	-.048	-.319	-.604	-.695	-.665
4	.100	.654	.728	.575	.394	.157	-.081	-.242	-.435	-.482	-.429
5	.150	.522	.585	.440	.268	.056	-.113	-.204	-.336	-.362	-.337
6	.200	.432	.488	.350	.280	.008	******	-.158	-.263	-.251	-.293
7	.250	.362	.422	.269	.123	-.032	-.123	-.149	-.214	-.203	-.166
8	.300	.308	.345	.203	.081	-.057	-.124	-.135	-.182	-.168	******
9	.400	.234	******	.124	.023	-.087	-.127	******	******	-.088	******
10	.500	.175	******	.060	******	******	-.148	******	-.060	-.082	-.062
11	.650	******	.118	.009	-.069	-.144	-.128	-.088	-.018	-.021	-.032
12	.780	.027	.045	-.026	-.096	-.153	-.154	-.073	.009	-.001	-.027
13	.900	-.069	-.034	-.088	-.152	-.225	-.184	-.099	-.040	-.043	-.042
14	.050	-1.705	-1.883	-1.491	-1.066	-.622	-.222	.071	.395	.513	.497
15	.100	-1.090	-1.010	-.834	-.660	-.429	-.203	.001	.268	.393	.355
16	.200	-.635	-.599	-.527	-.430	-.292	-.152	-.042	.137	.220	.187
17	.300	-.454	-.446	-.347	-.300	-.221	-.132	-.062	.088	.139	.107
18	.500	- 210	-.236	-.191	-.152	-.124	-.098	-.063	.030	.060	.034
19	.650	******	-.149	-.141	-.127	-.105	-.077	-.058	.019	.033	.021
20	.780	-.081	-.097	-.110	-.114	-.111	-.097	-.067	-.004	.007	-.008
21	.900	-.106	-.122	-.148	-.115	-.116	-.113	-.098	-.091	-.044	-.053

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.3.- CONTINUED

RUN 56 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.059	-.046	******	-.288	******	-.622	-.739	-.520	.249
2	.025	.362	.478	.576	.743	.762	.878	.965	.851	.364
3	.050	.239	.347	.454	.552	.611	.681	.737	.671	.377
4	.100	.141	.223	.298	.408	.435	.506	.532	.478	.346
5	.150	.103	.168	.243	.314	.343	.397	.420	.397	.311
6	.200	.075	.145	.185	.258	.287	.335	.352	.329	.288
7	.250	.050	.110	.164	.221	.249	.289	.293	.278	.251
8	.300	.036	.085	.127	.186	.209	.240	.245	.232	******
9	.400	.019	.056	.098	.140	.162	.180	.179	.172	******
10	.500	-.005	.034	.067	.102	.118	.145	.135	.132	.122
11	.650	******	.031	.045	.069	.087	.097	.089	.062	.055
12	.780	-.005	.016	.035	.057	.064	.071	.021	.005	.023
13	.900	-.095	-.099	-.080	-.088	-.051	-.020	-.076	-.054	
14	.050	-.362	-.500	-.645	-.808	-.911	-1.022	-1.240	-.817	
15	.100	-.272	-.365	-.466	-.574	-.664	-.767	-.898	-1.088	
16	.200	-.178	-.235	-.303	-.383	-.433	-.521	-.533	-.601	
17	.300	-.126	-.178	-.232	-.286	-.329	-.351	-.346	-.341	
18	.500	-.129	-.158	-.138	-.122	-.147	-.192	-.211	******	
19	.650	-.010	-.034	-.067	-.097	-.111	-.134	-.157	-.264	
20	.780	-.065	-.058	-.069	-.090	-.103	-.117	-.127	-.098	
21	.900	-.048	-.055	-.058	-.057	-.074	-.093	-.132	-.136	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.401	-1.612	-1.612	******	-1.159	-2.372	-2.255	-1.196	-1.226	-.521
2	.025	1.113	1.192	1.178	.502	-1.185	-2.003	-2.431	-1.904	-1.745	-1.249
3	.050	.914	1.026	1.005	.457	-1.043	-1.493	-1.838	-1.582	-1.445	-.869
4	.100	.637	.772	.678	.112	-1.029	-.936	-1.006	-.861	-.865	-.598
5	.150	.496	.613	.507	-.048	-1.011	-.689	-.696	-.702	-.630	-.492
6	.200	.411	.509	.366	-.158	-.933	******	-.480	-.542	-.478	-.365
7	.250	.335	.419	.289	-.169	-.861	-.471	-.325	-.443	-.404	-.261
8	.300	.284	.337	.197	-.186	-.819	-.421	-.250	-.375	-.342	******
9	.400	.200	******	.038	-.208	-.697	-.405	******	******	-.213	******
10	.500	.128	******	.011	******	******	-.417	******	-.186	-.190	-.161
11	.650	******	.030	-.056	-.255	-.575	-.494	-.123	-.096	-.101	-.126
12	.780	-.058	-.085	-.145	-.263	-.517	-.465	-.130	-.046	-.062	-.123
13	.900	-.196	-.254	-.302	-.363	-.493	-.482	-.203	-.095	-.095	-.127
14	.050	-1.125	-1.101	-.438	-.444	-.143	.670	.944	.826	.791	.604
15	.100	-.700	-.930	-.344	-.346	-.114	.385	.578	.641	.630	.452
16	.200	-.364	-.662	-.369	-.362	-.218	.086	.334	.385	.375	.254
17	.300	-.422	-.578	-.475	-.448	-.330	-.094	.137	.253	.251	.150
18	.500	-.396	-.500	-.520	-.500	-.451	-.249	-.056	.105	.111	.056
19	.650	******	-.498	-.535	-.533	-.502	-.316	-.134	.048	.056	.027
20	.780	-.365	-.412	-.481	-.458	-.420	-.330	-.193	-.023	.010	-.014
21	.900	-.356	-.475	-.491	-.454	-.447	-.374	-.260	-.082	-.061	-.061

TABLE A.3.- CONTINUED

RUN 57 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.205	-.199	******	-.376	******	-.577	-.772	-.655	.073
2	.025	.410	.467	.507	.628	.701	.798	.944	.836	.481
3	.050	.232	.330	.436	.537	.574	.669	.727	.658	.356
4	.100	.131	.211	.287	.392	.422	.491	.522	.475	.334
5	.150	.098	.161	.223	.300	.344	.383	.409	.386	.307
6	.200	.065	.131	.177	.242	.277	.329	.343	.321	.274
7	.250	.049	.104	.152	.211	.242	.288	.287	.271	.239
8	.300	.034	.077	.124	.177	.200	.230	.241	.228	******
9	.400	.018	.056	.093	.133	.157	.177	.180	.169	******
10	.500	-.005	.030	.062	.094	.120	.140	.132	.132	.120
11	.650	******	.026	.042	.063	.073	.085	.086	.061	.058
12	.780	-.004	.017	.032	.055	.061	.073	.033	.011	.024
13	.900	-.095	-.100	-.084	-.093	-.053	-.024	-.057	-.042	
14	.050	-.376	-.495	-.617	-.749	-.868	-1.018	-1.261	-1.005	
15	.100	-.265	-.352	-.435	-.564	-.630	-.740	-.880	-1.251	
16	.200	-.171	-.227	-.292	-.369	-.407	-.515	-.583	-.589	
17	.300	-.123	-.175	-.218	-.283	-.325	-.344	-.341	-.329	
18	.500	-.125	-.156	-.136	-.117	-.142	-.179	-.171	******	
19	.650	-.009	-.031	-.061	-.093	-.110	-.127	-.124	-.125	
20	.780	-.061	-.054	-.067	-.084	-.100	-.105	-.085	-.065	
21	.900	-.044	-.051	-.054	-.053	-.070	-.080	-.106	-.087	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.065	-1.326	-1.409	******	-1.123	-1.063	-1.755	-1.234	-1.173	-.593
2	.025	1.039	1.111	1.183	1.102	.553	-.682	-1.889	-1.447	-1.359	-1.006
3	.050	.863	1.015	1.108	1.042	.441	-.979	-1.414	-1.708	-1.412	-.934
4	.100	.605	.742	.797	.711	.135	-.995	-.907	-.827	-.843	-.638
5	.150	.480	.596	.632	.509	-.012	-.967	-.675	-.707	-.631	-.505
6	.200	.396	.502	.494	.389	-.101	******	-.572	-.534	-.469	-.351
7	.250	.322	.415	.395	.294	-.151	-.851	-.495	-.426	-.398	-.278
8	.300	.278	.339	.312	.221	-.167	-.834	-.482	-.352	-.335	******
9	.400	.195	******	.186	.106	-.218	-.708	******	******	-.207	******
10	.500	.128	******	.085	******	******	-.697	******	-.169	-.178	-.166
11	.650	******	.053	-.019	-.051	-.235	-.552	-.509	-.068	-.097	-.130
12	.780	-.045	-.059	-.126	-.143	-.243	-.481	-.461	-.035	-.055	-.116
13	.900	-.184	-.198	-.271	-.305	-.373	-.494	-.487	-.106	-.083	-.116
14	.050	-1.104	-1.369	-.664	-.361	-.349	-.170	.532	.863	.762	.618
15	.100	-.700	-.892	-.536	-.338	-.296	-.158	.396	.650	.610	.467
16	.200	-.385	-.669	-.467	-.374	-.372	-.231	.059	.371	.361	.256
17	.300	-.338	-.554	-.539	-.454	-.432	-.343	-.107	.234	.234	.148
18	.500	-.355	-.407	-.561	-.517	-.530	-.432	-.275	.066	.096	.047
19	.650	******	-.363	-.571	-.535	-.492	-.463	-.319	.005	.039	.017
20	.780	-.334	-.306	-.489	-.468	-.465	-.469	-.350	-.074	-.017	-.032
21	.900	-.366	-.361	-.547	-.448	-.475	-.436	-.401	-.129	-.082	-.074

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OF POOR QUALITY

TABLE A.3.- CONTINUED

RUN 58 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.044	-.042	******	-.286	******	-.593	-.708	-.526	.270
2	.025	.329	.432	.516	.664	.735	.853	.948	.836	.336
3	.050	.224	.326	.439	.551	.590	.675	.725	.657	.363
4	.100	.140	.224	.297	.396	.427	.495	.528	.460	.343
5	.150	.102	.174	.220	.301	.349	.386	.414	.391	.307
6	.200	.067	.127	.178	.257	.287	.330	.346	.327	.288
7	.250	.048	.101	.154	.212	.247	.288	.291	.275	.251
8	.300	.032	.081	.120	.182	.208	.239	.246	.232	******
9	.400	.020	.057	.094	.135	.158	.178	.183	.176	******
10	.500	-.003	.033	.053	.101	.120	.142	.139	.138	.126
11	.650	******	.029	.046	.072	.084	.097	.099	.070	.066
12	.780	-.006	.016	.033	.057	.064	.072	.030	.014	.031
13	.900	-.093	-.099	-.084	-.095	-.052	-.022	-.067	-.043	
14	.050	-.362	-.486	-.591	-.755	-.859	-.986	-1.226	-.913	
15	.100	-.259	-.339	-.440	-.543	-.632	-.744	-.835	-1.140	
16	.200	-.163	-.225	-.284	-.359	-.414	-.504	-.596	-.677	
17	.300	-.118	-.173	-.223	-.285	-.320	-.336	-.330	-.341	
18	.500	-.119	-.148	-.127	-.116	-.135	-.181	-.208	******	
19	.650	-.005	-.032	-.063	-.091	-.104	-.124	-.139	-.122	
20	.780	-.061	-.055	-.066	-.085	-.102	-.110	-.104	-.099	
21	.900	-.044	-.051	-.053	-.049	-.069	-.082	-.141	-.114	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.451	-1.398	-1.373	******	-.955	-1.740	-2.378	-1.415	-1.302	-.538
2	.025	1.084	1.152	1.212	.954	-.088	-1.590	-2.742	-2.120	-1.918	-1.303
3	.050	.895	.985	1.039	.816	-.025	-1.189	-1.603	-1.805	-1.571	-.897
4	.100	.624	.732	.716	.480	-.147	-.742	-1.047	-.923	-.896	-.620
5	.150	.496	.587	.544	.344	-.128	-.527	-.784	-.756	-.665	-.494
6	.200	.404	.494	.412	.215	-.149	******	-.569	-.590	-.509	-.372
7	.250	.335	.410	.314	.134	-.194	-.383	-.450	-.495	-.434	-.276
8	.300	.288	.33[illegible]	.247	.114	-.177	-.302	-.442	-.427	-.373	******
9	.400	.205	******	.135	.002	-.142	-.249	******	******	-.238	******
10	.500	.139	******	.055	******	******	-.175	******	-.247	-.215	-.175
11	.650	******	.051	-.022	-.082	-.150	-.128	-.133	-.145	-.125	-.145
12	.780	-.026	-.048	-.117	-.103	-.202	-.129	-.120	-.083	-.080	-.138
13	.900	-.149	-.172	-.238	-.262	-.250	-.185	-.185	-.111	-.103	-.131
14	.050	-1.314	-.906	-.925	-.921	-.868	.335	.944	.878	.810	.616
15	.100	-.811	-.703	-.823	-.825	-.879	.013	.693	.689	.652	.467
16	.200	-.487	-.612	-.732	-.725	-.818	-.165	.326	.411	.396	.258
17	.300	-.390	-.560	-.665	-.696	-.835	-.313	.150	.292	.267	.165
18	.500	-.281	-.405	-.539	-.520	-.709	-.292	-.002	.129	.124	.062
19	.650	******	-.342	-.440	-.479	-.556	-.256	-.044	.065	.064	.033
20	.780	-.220	-.256	-.305	-.426	-.459	-.255	-.094	-.002	.017	-.014
21	.900	-.286	-.307	-.374	-.364	-.416	-.250	-.182	-.075	-.058	-.062

TABLE A.3.- CONTINUED

RUN 59 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.005	-.006	******	-.096	******	-.250	-.278	-.231	.194
2	.025	.241	.340	.405	.512	.565	.669	.750	.682	.244
3	.050	.165	.254	.327	.399	.435	.503	.552	.517	.269
4	.100	.083	.146	.213	.280	.306	.369	.381	.351	.246
5	.150	.063	.110	.144	.212	.241	.280	.316	.297	.222
6	.200	.040	.093	.115	.176	.192	.244	.252	.247	.220
7	.250	.024	.065	.101	.149	.167	.206	.217	.201	.192
8	.300	.012	.043	.077	.117	.142	.164	.173	.165	******
9	.400	.004	.031	.059	.087	.106	.116	.131	.128	******
10	.500	-.017	.009	.030	.057	.073	.094	.101	.105	.106
11	.650	******	.008	.021	.043	.055	.065	.077	.054	.062
12	.780	-.015	.001	.013	.027	.033	.042	.022	.012	.034
13	.900	-.081	-.100	-.083	-.109	-.078	-.047	-.067	-.022	
14	.050	-.270	-.367	-.454	-.554	-.634	-.721	-.918	-.834	
15	.100	-.209	-.262	-.335	-.420	-.467	-.555	-.665	-.879	
16	.200	-.141	-.173	-.222	-.272	-.297	-.362	-.442	-.432	
17	.300	-.099	-.142	-.174	-.211	-.231	-.267	-.262	-.263	
18	.500	-.103	-.128	-.142	-.133	-.109	-.122	-.126	******	
19	.650	.006	-.012	-.032	-.058	-.069	-.086	-.081	-.103	
20	.780	-.056	-.043	-.051	-.057	-.075	-.082	-.059	-.049	
21	.900	-.038	-.042	-.043	-.037	-.050	-.058	-.053	-.049	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-.822	-.947	-.963	******	-1.735	-1.723	-1.592	-1.701	-1.513	-1.075
2	.025	.919	.996	1.158	1.175	1.195	1.248	1.223	1.287	.983	-1.152
3	.050	.730	.819	.968	1.013	1.033	1.063	1.081	1.130	.798	-.825
4	.100	.486	.601	.690	.734	.759	.792	.810	.857	.557	-.676
5	.150	.395	.476	.567	.583	.600	.623	.646	.686	.403	-.645
6	.200	.327	.413	.467	.491	.513	******	.548	.554	.269	-.652
7	.250	.270	.347	.408	.416	.425	.441	.453	.466	.181	-.642
8	.300	.238	.302	.348	.370	.371	.381	.378	.378	.102	******
9	.400	.180	******	.256	.264	.269	.272	******	******	.024	******
10	.500	.139	******	.191	******	******	.200	******	.134	-.076	-.620
11	.650	******	.122	.120	.118	.109	.103	.087	.014	-.131	-.631
12	.780	.027	.065	.057	.047	.036	.018	-.014	-.095	-.206	-.628
13	.900	-.070	-.018	-.031	-.046	-.066	-.108	-.156	-.312	-.353	-.621
14	.050	-1.157	-1.298	-1.659	-1.884	-2.076	-2.019	-1.469	-.619	-.396	-.072
15	.100	-.824	-.916	-.906	-.932	-1.040	-1.070	-1.091	-.459	-.292	-.152
16	.200	-.566	-.552	-.634	-.669	-.681	-.688	-.840	-.541	-.363	-.302
17	.300	-.355	-.405	-.463	-.473	-.485	-.515	-.608	-.543	-.474	-.374
18	.500	-.181	-.226	-.252	-.257	-.287	-.336	-.388	-.634	-.558	-.507
19	.650	******	-.146	-.179	-.194	-.219	-.276	-.342	-.693	-.607	-.591
20	.780	-.085	-.126	-.125	-.134	-.155	-.214	-.257	-.629	-.607	-.560
21	.900	-.085	-.130	-.138	-.074	-.134	-.185	-.279	-.668	-.597	-.560

TABLE A.3.- CONTINUED

RUN 60 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.032	-.031	******	-.268	******	-.613	-.776	-.555	.265
2	.025	.340	.460	.533	.695	.760	.858	.956	.851	.354
3	.050	.235	.328	.444	.557	.602	.685	.746	.669	.374
4	.100	.135	.225	.298	.401	.433	.497	.532	.481	.343
5	.150	.098	.168	.223	.319	.354	.391	.419	.395	.311
6	.200	.069	.135	.188	.255	.280	.335	.348	.332	.289
7	.250	.051	.109	.161	.215	.246	.298	.297	.277	.251
8	.300	.035	.082	.123	.180	.206	.240	.251	.234	******
9	.400	.021	.058	.096	.140	.158	.179	.186	.177	******
10	.500	-.004	.033	.066	.105	.121	.147	.141	.139	.126
11	.650	******	.021	.045	.074	.087	.101	.099	.070	.066
12	.780	-.002	.017	.032	.056	.064	.073	.033	.012	.025
13	.900	-.094	-.098	-.083	-.089	-.048	-.017	-.058	-.040	
14	.050	-.360	-.499	-.628	-.782	-.866	-1.034	-1.295	-.957	
15	.100	-.268	-.353	-.447	-.552	-.628	-.748	-.907	-1.190	
16	.200	-.168	-.224	-.291	-.375	-.428	-.516	-.604	-.656	
17	.300	-.118	-.174	-.218	-.291	-.324	-.341	-.338	-.351	
18	.500	-.114	-.153	-.133	-.119	-.142	-.183	-.185	******	
19	.650	-.011	-.031	-.060	-.092	-.108	-.128	-.137	-.129	
20	.780	-.061	-.056	-.067	-.084	-.101	-.102	-.106	-.072	
21	.900	-.045	-.052	-.053	-.052	-.070	-.086	-.114	-.096	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.435	-1.602	-1.600	******	-1.124	-1.600	-2.339	-1.295	-1.314	-.583
2	.025	1.099	1.184	1.240	.990	-.154	-1.063	-2.479	-1.934	-1.832	-1.307
3	.050	.900	1.020	1.084	.832	-.211	-1.288	-1.602	-1.638	-1.467	-.906
4	.100	.632	.754	.771	.526	-.401	-.924	-.952	-.817	-.857	-.616
5	.150	.498	.604	.592	.348	-.476	-.875	-.665	-.696	-.632	-.499
6	.200	.409	.509	.455	.233	-.501	******	-.436	-.538	-.473	-.350
7	.250	.335	.420	.358	.137	-.504	-.826	-.375	-.430	-.400	-.266
8	.300	.286	.343	.283	.078	-.475	-.792	-.312	-.368	-.336	******
9	.400	.200	******	.157	.004	-.402	-.729	******	******	-.211	******
10	.500	.136	******	.069	******	******	-.704	******	-.181	-.166	-.150
11	.650	******	.040	-.025	-.098	-.370	-.617	-.212	-.073	-.092	-.129
12	.780	-.040	-.065	-.139	-.184	-.358	-.513	-.252	-.044	-.057	-.119
13	.900	-.171	-.219	-.298	-.320	-.413	-.534	-.343	-.102	-.089	-.122
14	.050	-1.274	-1.186	-.423	-.322	-.371	.266	.848	.851	.791	.624
15	.100	-.712	-.890	-.425	-.299	-.303	.100	.588	.654	.627	.458
16	.200	-.459	-.686	-.355	-.323	-.343	-.109	.223	.381	.376	.251
17	.300	-.398	-.580	-.445	-.435	-.404	-.215	.027	.253	.250	.154
18	.500	-.356	-.444	-.528	-.509	-.499	-.347	-.145	.090	.109	.054
19	.650	******	-.430	-.544	-.548	-.508	-.418	-.228	.028	.052	.027
20	.780	-.300	-.366	-.485	-.481	-.483	-.445	-.271	-.040	.003	-.018
21	.900	-.347	-.396	-.530	-.458	-.475	-.449	-.363	-.099	-.078	-.069

TABLE A.3.- CONTINUED

RUN 61   AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.090	-.089	******	-.568	******	-1.035	-.813	-.369	.360
2	.025	.433	.586	.670	.868	.920	1.017	1.043	.905	.494
3	.050	.314	.434	.565	.698	.755	.825	.820	.738	.503
4	.100	.188	.292	.392	.510	.556	.620	.611	.547	.447
5	.150	.146	.232	.302	.408	.444	.487	.478	.443	.375
6	.200	.101	.189	.250	.339	.366	.409	.393	.370	.333
7	.250	.080	.159	.221	.289	.321	.356	.333	.310	.279
8	.300	.060	.123	.175	.238	.262	.283	.268	.246	******
9	.400	.035	.088	.135	.184	.202	.205	.181	.165	******
10	.500	.008	.059	.099	.138	.151	.149	.107	.103	.085
11	.650	******	.040	.070	.095	.102	.079	.029	.004	-.003
12	.780	.001	.033	.049	.071	.070	.026	-.096	-.086	-.047
13	.900	-.067	-.082	-.068	-.065	-.027	-.049	-.215	-.199	
14	.050	-.459	-.622	-.810	-1.030	-1.170	-1.379	-.830	-.064	
15	.100	-.330	-.454	-.578	-.714	-.833	-.904	-.273	-.035	
16	.200	-.205	-.278	-.379	-.492	-.516	-.529	-.127	.006	
17	.300	-.138	-.209	-.282	-.321	-.348	-.389	-.163	-.103	
18	.500	-.092	-.134	-.141	-.173	-.195	-.236	-.327	******	
19	.650	-.024	-.059	-.091	-.132	-.147	-.195	-.466	-.482	
20	.780	-.074	-.073	-.083	-.108	-.124	-.173	-.530	-.487	
21	.900	-.060	-.065	-.070	-.076	-.095	-.145	-.580	-.474	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-2.577	-1.700	-1.909	******	-1.515	-1.560	-1.369	-.951	-.763	-.271
2	.025	1.282	-1.510	-2.144	-2.146	-2.203	-2.213	-2.158	-1.645	-1.404	-.951
3	.050	1.077	-1.211	-1.659	-1.820	-1.763	-1.800	-1.706	-1.239	-1.002	-.660
4	.100	.739	-.948	-.940	-.981	-1.009	-1.010	-1.007	-.987	-.693	-.444
5	.150	.545	-.870	-.755	-.764	-.759	-.765	-.749	-.596	-.570	-.356
6	.200	.413	-.848	-.596	-.576	-.591	******	-.578	-.476	-.430	-.300
7	.250	.304	-.834	-.523	-.464	-.480	-.479	-.493	-.406	-.330	-.257
8	.300	.232	-.848	-.401	-.376	-.397	-.399	-.409	-.357	-.237	******
9	.400	.116	******	-.276	-.240	-.267	-.268	******	******	-.184	******
10	.500	.029	******	-.180	******	******	-.206	******	-.213	-.182	-.119
11	.650	******	-.603	-.114	-.101	-.115	-.112	-.127	-.126	-.106	-.099
12	.780	-.170	-.500	-.100	-.059	-.079	-.055	-.073	-.071	-.072	-.092
13	.900	-.307	-.462	-.191	-.178	-.111	-.097	-.088	-.090	-.099	-.100
14	.050	-.921	.221	.945	.911	.891	.907	.904	.788	.674	.493
15	.100	-.456	.097	.677	.690	.696	.687	.723	.626	.528	.371
16	.200	-.185	-.033	.437	.430	.464	.472	.464	.400	.331	.214
17	.300	-.131	-.159	.287	.309	.328	.335	.334	.293	.240	.136
18	.500	-.283	-.195	.103	.137	.151	.165	.170	.158	.129	.063
19	.650	******	-.247	.016	.052	.077	.094	.101	.108	.090	.048
20	.780	-.479	-.321	-.073	-.031	.003	.021	.033	.053	.057	.014
21	.900	-.542	-.385	-.186	-.117	-.091	-.059	-.049	-.034	-.034	-.058

TABLE A.3.- CONTINUED

RUN 62 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.559	-.874	******	-1.009	******	-2.014	-2.215	-2.938	-.246
2	.025	.831	1.054	1.126	-.968	-2.074	-2.426	-2.685	-2.206	-.695
3	.050	.642	.861	1.036	-.933	-1.327	-1.692	-1.522	-1.267	-.654
4	.100	.413	.624	.754	-.993	-1.009	-1.065	-1.051	-.877	-.604
5	.150	.327	.491	.595	-.933	-.817	-.808	-.782	-.658	-.523
6	.200	.246	.399	.485	-.936	-.714	-.603	-.582	-.511	-.432
7	.250	.194	.326	.397	-.885	-.510	-.475	-.480	-.429	-.385
8	.300	.144	.260	.322	-.832	-.395	-.362	-.368	-.344	******
9	.400	.092	.179	.233	-.750	-.316	-.241	-.257	-.254	******
10	.500	.041	.121	.118	-.701	-.225	-.149	-.193	-.194	-.209
11	.650	******	.060	.035	-.557	-.156	-.065	-.085	-.115	-.138
12	.780	.026	.026	-.033	-.453	-.153	-.056	-.042	-.082	-.095
13	.900	-.064	-.056	-.148	-.413	-.232	-.125	-.054	-.072	
14	.050	-.932	-1.418	-1.213	-.224	.951	.952	1.027	1.078	
15	.100	-.623	-.952	-.818	-.219	.678	.738	.832	.883	
16	.200	-.418	-.532	-.658	-.274	.376	.489	.552	.613	
17	.300	-.250	-.390	-.527	-.315	.186	.350	.406	.401	
18	.500	-.157	-.231	-.473	-.331	.010	.170	.208	******	
19	.650	-.107	-.160	-.441	-.369	-.066	.083	.112	.089	
20	.780	-.158	-.144	-.343	-.304	-.144	-.009	.010	.006	
21	.900	-.139	-.135	-.328	-.271	-.215	-.090	-.075	-.066	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.065	-1.234	-1.143	******	-.582	-.501	-.380	-.317	-.189	-.067
2	.025	-1.905	-1.562	-1.368	-1.295	-1.268	-1.203	-1.132	-.941	-.755	-.566
3	.050	-1.490	-1.210	-1.014	-.984	-.941	-.907	-.852	-.656	-.555	-.391
4	.100	-.891	-.887	-.791	-.744	-.648	-.625	-.596	-.491	-.394	-.271
5	.150	-.674	-.604	-.543	-.572	-.539	-.508	-.470	-.383	-.313	-.216
6	.200	-.529	-.470	-.423	-.421	-.409	******	-.367	-.309	-.247	-.162
7	.250	-.479	-.403	-.358	-.330	-.329	-.323	-.320	-.260	-.217	-.131
8	.300	-.357	-.359	-.311	-.279	-.271	-.248	-.260	-.213	-.175	******
9	.400	-.255	******	-.216	-.195	-.195	-.174	******	******	-.148	******
10	.500	-.213	******	-.198	******	******	-.159	******	-.125	-.090	-.048
11	.650	******	-.121	-.117	-.111	-.109	-.102	-.090	-.067	-.043	-.032
12	.780	-.080	-.086	-.088	-.081	-.075	-.060	-.069	-.034	-.029	-.032
13	.900	-.082	-.091	-.102	-.101	-.098	-.094	-.081	-.067	-.053	-.038
14	.050	.916	.771	.685	.670	.665	.630	.594	.511	.443	.316
15	.100	.716	.598	.508	.512	.499	.455	.460	.382	.349	.231
16	.200	.487	.419	.363	.347	.342	.322	.312	.245	.212	.142
17	.300	.350	.305	.273	.266	.259	.244	.223	.186	.149	.088
18	.500	.199	.185	.172	.166	.158	.146	.137	.109	.089	.046
19	.650	******	.145	.131	.125	.119	.115	.107	.088	.068	.044
20	.780	.046	.080	.091	.087	.083	.079	.071	.054	.040	.015
21	.900	-.025	-.019	-.022	.012	.005	.007	-.002	-.031	-.044	-.051

TABLE A.3.- CONTINUED

RUN 63 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.028	-.029	******	-.286	******	-.578	-.756	-.561	.268
2	.025	.352	.467	.541	.701	.762	.855	.974	.870	.368
3	.050	.245	.331	.434	.546	.609	.682	.753	.680	.400
4	.100	.137	.222	.297	.394	.423	.502	.538	.487	.367
5	.150	.103	.170	.230	.319	.351	.402	.429	.401	.325
6	.200	.075	.138	.191	.250	.290	.336	.356	.341	.305
7	.250	.048	.109	.161	.213	.249	.299	.304	.287	.264
8	.300	.036	.083	.120	.180	.198	.241	.253	.238	******
9	.400	.019	.058	.093	.132	.155	.177	.184	.184	******
10	.500	-.003	.035	.062	.100	.117	.147	.142	.142	.136
11	.650	******	.020	.045	.072	.087	.102	.102	.075	.075
12	.780	.063	.017	.029	.055	.064	.072	.037	.018	.038
13	.900	-.093	-.093	-.081	-.089	-.045	-.017	-.048	-.037	
14	.050	-.349	-.471	-.608	-.748	-.870	-1.039	-1.273	-.937	
15	.100	-.268	-.353	-.438	-.545	-.625	-.736	-.917	-1.195	
16	.200	-.157	-.220	-.299	-.360	-.412	-.511	-.599	-.644	
17	.300	-.115	-.167	-.224	-.274	-.316	-.341	-.388	-.357	
18	.500	-.118	-.149	-.133	-.124	-.143	-.178	-.183	******	
19	.650	-.007	-.028	-.061	-.093	-.108	-.126	-.134	-.131	
20	.780	-.062	-.053	-.065	-.084	-.102	-.106	-.089	-.067	
21	.900	-.042	-.049	-.053	-.048	-.070	-.087	-.122	-.117	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.960	-1.409	-1.451	******	-1.181	-1.820	-1.845	-1.357	-1.281	-.577
2	.025	1.169	1.172	1.223	.868	-.337	-1.418	-1.691	-2.014	-1.898	-1.330
3	.050	.969	1.005	1.071	.723	-.457	-1.057	-1.196	-1.706	-1.541	-.908
4	.100	.676	.752	.732	.420	-.526	-.856	-.958	-.872	-.880	-.620
5	.150	.530	.595	.549	.251	-.555	-.832	-.895	-.714	-.657	-.503
6	.200	.434	.505	.420	.148	-.594	******	-.754	-.565	-.494	-.354
7	.250	.352	.411	.326	.055	-.540	-.734	-.698	-.467	-.417	-.277
8	.300	.303	.340	.231	.051	-.475	-.663	-.436	-.404	-.357	******
9	.400	.208	******	.125	-.051	-.440	-.509	******	******	-.228	******
10	.500	.152	******	.036	******	******	-.478	******	-.223	-.205	-.171
11	.650	******	.037	-.057	-.130	-.319	-.393	-.211	-.129	-.116	-.140
12	.780	-.012	-.076	-.164	-.203	-.315	-.351	-.236	-.075	-.075	-.134
13	.900	-.110	-.234	-.323	-.335	-.395	-.355	-.289	-.119	-.099	-.129
14	.050	-1.751	-.972	-.360	-.403	-.512	.368	.879	.868	.805	.627
15	.100	-1.089	-.740	-.391	-.351	-.346	.044	.628	.669	.637	.477
16	.200	-.666	-.621	-.326	-.397	-.415	-.131	.262	.394	.385	.266
17	.300	-.473	-.542	-.432	-.448	-.469	-.231	.079	.266	.259	.156
18	.500	-.240	-.485	-.508	-.492	-.504	-.349	-.118	.097	.112	.051
19	.650	******	-.477	-.545	-.542	-.512	-.394	-.164	.032	.052	.028
20	.780	-.145	-.409	-.464	-.481	-.488	-.418	-.234	-.044	.001	-.020
21	.900	-.164	-.453	-.523	-.464	-.488	-.430	-.326	-.108	-.085	-.077

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TABLE A.3.- CONTINUED

RUN 64 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.132	-.168	******	-1.032	******	-2.154	-2.128	-.701	-.411
2	.025	.534	.689	.811	1.042	1.102	1.217	1.196	.827	-.512
3	.050	.389	.546	.703	.855	.928	1.041	1.003	.651	-.433
4	.100	.250	.378	.490	.649	.713	.807	.736	.384	-.430
5	.150	.189	.295	.390	.505	.572	.648	.547	.310	-.421
6	.200	.139	.243	.325	.423	.474	.531	.427	.198	-.508
7	.250	.106	.199	.277	.362	.400	.452	.328	.090	-.492
8	.300	.080	.159	.227	.304	.340	.369	.262	.036	******
9	.400	.053	.115	.177	.234	.255	.257	.155	.011	******
10	.500	.022	.084	.134	.174	.183	.171	.078	-.045	-.464
11	.650	******	.058	.090	.114	.111	.074	.003	-.086	-.403
12	.780	.010	.050	.076	.086	.072	-.004	-.103	-.151	-.382
13	.900	-.077	-.064	-.041	-.041	-.041	-.114	-.186	-.207	
14	.050	-.542	-.763	-1.001	-1.450	-1.810	-1.781	-1.297	-.686	
15	.100	-.373	-.519	-.696	-.751	-.904	-1.159	-.742	-.579	
16	.200	-.236	-.342	-.476	-.563	-.610	-.636	-.341	-.261	
17	.300	-.173	-.264	-.326	-.413	-.449	-.437	-.246	-.190	
18	.500	-.067	-.126	-.187	-.213	-.230	-.223	-.253	******	
19	.650	-.041	-.081	-.119	-.154	-.161	-.199	-.295	-.315	
20	.780	-.068	-.088	-.103	-.108	-.110	-.151	-.354	-.285	
21	.900	-.071	-.077	-.085	-.078	-.082	-.206	-.396	-.361	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.108	-1.869	-1.870	******	-1.202	-1.034	-.894	-.620	-.479	-.162
2	.025	-1.741	-2.091	-2.135	-1.981	-1.968	-1.760	-1.722	-1.375	-1.107	-.780
3	.050	-1.160	-1.772	-1.727	-1.572	-1.511	-1.342	-1.253	-.973	-.807	-.525
4	.100	-.755	-.915	-.938	-.876	-.910	-.958	-.933	-.692	-.539	-.354
5	.150	-.560	-.720	-.717	-.683	-.679	-.625	-.599	-.554	-.439	-.235
6	.200	-.450	-.561	-.533	-.562	-.558	******	-.474	-.420	-.364	-.235
7	.250	-.399	-.463	-.481	-.477	-.464	-.432	-.430	-.320	-.305	-.194
8	.300	-.281	-.395	-.404	-.398	-.386	-.373	-.365	-.285	-.236	******
9	.400	-.195	******	-.275	-.273	-.273	-.255	******	******	-.147	******
10	.500	-.152	******	-.225	******	******	-.216	******	-.189	-.150	-.084
11	.650	******	-.079	-.117	-.127	-.132	-.129	-.124	-.109	-.082	-.069
12	.780	-.111	-.053	-.071	-.079	-.077	-.069	-.085	-.062	-.058	-.066
13	.900	-.192	-.103	-.105	-.108	-.103	-.106	-.095	-.093	-.087	-.067
14	.050	.810	.858	.913	.894	.866	.843	.793	.675	.589	.426
15	.100	.620	.664	.683	.684	.666	.621	.622	.541	.464	.319
16	.200	.389	.445	.472	.457	.457	.439	.409	.339	.283	.190
17	.300	.244	.306	.337	.339	.332	.322	.299	.256	.199	.115
18	.500	.079	.148	.184	.193	.186	.184	.174	.147	.119	.057
19	.650	******	.092	.118	.125	.127	.128	.126	.108	.086	.049
20	.780	-.101	.017	.050	.058	.066	.067	.071	.067	.057	.015
21	.900	-.177	-.082	-.058	-.006	-.005	.002	-.002	-.009	-.026	-.051

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TABLE A.3.- CONTINUED

RUN 65 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	-.118	-.130	******	-.785	******	-1.571	-1.293	-.536	.384
2	.025	.464	.642	.757	.959	1.015	1.135	1.153	1.092	.525
3	.050	.353	.435	.649	.773	.845	.938	.937	.622	.529
4	.100	.224	.360	.431	.584	.645	.724	.705	.623	.454
5	.150	.166	.265	.339	.453	.515	.577	.558	.495	.367
6	.200	.127	.219	.245	.336	.421	.480	.448	.434	.307
7	.250	.095	.179	.247	.329	.363	.456	.367	.321	.235
8	.300	.069	.140	.211	.275	.301	.328	.299	.259	******
9	.400	.047	.105	.154	.212	.232	.230	.192	.167	******
10	.500	.018	.074	.122	.160	.171	.165	.112	.092	.051
11	.650	******	.052	.080	.106	.106	.073	.019	-.006	-.019
12	.750	.005	.044	.063	.083	.072	.010	-.101	-.097	-.043
13	.900	-.062	-.071	-.053	-.050	-.032	-.098	-.232	-.203	
14	.050	-.501	-.715	-.925	-1.202	-1.475	-1.736	-.955	-.073	
15	.100	-.343	-.434	-.631	-.620	-.848	-1.029	-.239	-.043	
16	.200	-.216	-.309	-.431	-.521	-.552	-.595	-.189	-.013	
17	.300	-.162	-.240	-.315	-.383	-.413	-.429	-.187	-.178	
18	.500	-.064	-.121	-.159	-.231	-.223	-.253	-.353	******	
19	.650	-.032	-.053	-.108	-.150	-.104	-.210	-.495	-.503	
20	.780	-.082	-.084	-.095	-.115	-.121	-.187	-.553	-.497	
21	.900	-.064	-.071	-.075	-.080	-.069	-.163	-.612	-.477	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.755	-3.164	-1.773	******	-1.433	-1.230	-1.093	-.746	-.575	-.204
2	.025	.168	-2.677	-2.142	-2.144	-2.132	-1.973	-1.898	-1.501	-1.209	-.648
3	.050	.109	-1.577	-1.595	-1.747	-1.728	-1.563	-1.493	-1.057	-.863	-.560
4	.100	-.310	-.950	-.945	-.952	-.967	-.913	-.913	-.776	-.565	-.339
5	.150	-.314	-.543	-.720	-.735	-.740	-.704	-.653	-.588	-.487	-.311
6	.200	-.426	-.421	-.569	-.581	-.575	******	-.521	-.419	-.413	-.258
7	.250	-.460	-.293	-.407	-.479	-.485	-.465	-.458	-.345	-.334	-.221
8	.300	-.283	-.201	-.391	-.387	-.432	-.397	-.391	-.317	-.253	******
9	.400	-.503	******	-.245	-.255	-.267	-.271	******	******	-.164	******
10	.500	-.373	******	-.197	******	******	-.219	******	-.252	-.165	-.101
11	.650	******	-.164	-.095	-.093	-.117	-.130	-.128	-.118	-.091	-.033
12	.760	-.318	-.170	-.104	-.067	-.064	-.069	-.085	-.070	-.067	-.077
13	.900	-.321	-.131	-.075	-.080	-.037	-.054	-.087	-.099	-.090	-.078
14	.050	-.531	.921	.875	.911	.900	.875	.835	.738	.620	.438
15	.100	-.347	.661	.654	.598	.709	.650	.666	.565	.485	.332
16	.200	-.411	.393	.444	.454	.466	.461	.435	.396	.303	.192
17	.300	-.412	.294	.311	.323	.335	.331	.311	.257	.213	.123
18	.500	-.270	.112	.153	.172	.175	.178	.173	.150	.123	.056
19	.650	******	-.043	.082	.095	.108	.116	.117	.108	.087	.048
20	.780	-.252	-.134	.038	.026	.047	.052	.057	.060	.056	.013
21	.900	-.301	-.211	-.079	-.037	-.032	-.012	-.015	-.013	-.023	-.051

TABLE A.3.- CONTINUED

RUN 66 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.027	-.019	******	-.183	******	-.302	-.276	-.138	.280
2	.025	.319	.425	.492	.622	.540	.724	.770	.681	.229
3	.050	.221	.310	.378	.473	.501	.547	.581	.490	.248
4	.100	.139	.232	.265	.347	.330	.404	.402	.366	.259
5	.150	.096	.157	.199	.266	.285	.330	.336	.316	.227
6	.200	.067	.132	.155	.218	.242	.274	.262	.252	.212
7	.250	.048	.101	.137	.182	.235	.234	.225	.233	.184
8	.300	.029	.058	.105	.151	.169	.292	.181	.173	******
9	.400	.016	.045	.070	.116	.130	.136	.139	.135	******
10	.500	-.001	.030	.055	.085	.101	.115	.115	.106	.102
11	.650	******	.010	.029	.055	.063	.074	.078	.052	.054
12	.780	-.006	.014	.032	.047	.049	.058	.033	.036	.033
13	.900	-.084	-.090	-.075	-.093	-.057	-.030	-.059	-.038	
14	.050	-.327	-.433	-.542	-.624	-.686	-.770	-.844	-.800	
15	.100	-.224	-.295	-.350	-.430	-.492	-.542	-.589	-.667	
16	.200	-.147	-.202	-.251	-.292	-.316	-.360	-.383	-.383	
17	.300	-.106	-.149	-.232	-.225	-.244	-.253	-.271	-.231	
18	.500	-.112	-.137	-.128	-.104	-.104	-.125	-.113	******	
19	.650	.004	-.018	-.042	-.065	-.070	-.074	-.059	-.080	
20	.780	-.060	-.053	-.039	-.067	-.074	-.074	-.048	-.040	
21	.900	-.037	-.044	-.042	-.033	-.046	-.050	-.029	-.030	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-.809	-.449	-.443	******	-.063	-.035	-.007	-.013	-.178	-.118
2	.025	.877	.773	.632	.545	.444	.331	.212	-.060	-.326	-.643
3	.050	.688	.534	.505	.346	.318	.234	.154	-.037	-.240	-.431
4	.100	.466	.433	.325	.283	.217	.158	.086	-.042	-.146	-.246
5	.150	.377	.349	.271	.262	.147	.104	.054	-.039	-.107	-.171
6	.200	.295	.293	.209	.197	.121	******	.054	-.040	-.085	-.143
7	.250	.225	.239	.200	.122	.079	.054	.031	-.034	-.074	-.110
8	.300	.271	.197	.133	.113	.065	.045	.013	-.030	-.055	******
9	.400	.150	******	.034	.064	.044	.019	******	******	-.034	******
10	.500	.114	******	.055	******	******	.014	******	-.021	-.025	-.002
11	.650	******	.070	.024	.014	.014	-.002	-.002	-.026	.005	.020
12	.780	.008	.023	-.002	-.015	-.020	-.017	-.041	-.016	-.000	.013
13	.900	-.092	-.072	-.104	-.115	-.107	-.065	-.016	-.031	-.037	.001
14	.050	-1.047	-.839	-.632	-.547	-.437	-.305	-.204	.010	.215	.335
15	.100	-.748	-.567	-.445	-.373	-.308	-.262	-.158	-.014	.184	.244
16	.200	-.465	-.391	-.276	-.253	-.207	-.153	-.121	-.019	.096	.116
17	.300	-.308	-.295	-.234	-.185	-.150	-.123	-.100	-.009	.065	.056
18	.500	-.148	-.144	-.107	-.119	-.116	-.083	-.065	-.013	.023	.018
19	.650	******	-.031	-.049	-.043	-.024	-.021	-.042	-.009	.025	.021
20	.780	-.064	-.037	-.067	-.059	-.052	-.036	-.013	-.007	.002	-.014
21	.900	-.053	-.089	-.090	-.038	-.035	-.033	-.033	-.016	-.033	-.042

TABLE A.3.- CONTINUED

RUN 67 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	-.028	-.020	******	-.247	******	-.527	-.643	-.445	.272
2	.025	.342	.445	.545	.685	.748	.853	.937	.854	.363
3	.050	.245	.344	.449	.543	.594	.668	.713	.666	.385
4	.100	.141	.231	.297	.405	.447	.501	.526	.490	.361
5	.150	.104	.173	.223	.314	.357	.399	.430	.410	.335
6	.200	.076	.142	.187	.260	.281	.341	.349	.336	.305
7	.250	.050	.112	.152	.215	.258	.293	.299	.259	.270
8	.300	.033	.084	.125	.171	.206	.235	.259	.246	******
9	.400	.023	.058	.095	.148	.153	.182	.198	.185	******
10	.500	.003	.040	.067	.107	.125	.151	.154	.157	.152
11	.650	******	.021	.045	.073	.083	.102	.110	.084	.087
12	.780	-.002	.017	.038	.056	.079	.080	.055	.052	.054
13	.900	-.062	-.051	-.075	-.084	-.043	-.010	-.040	-.013	
14	.050	-.344	-.445	-.597	-.735	-.620	-.992	-1.210	-.926	
15	.100	-.237	-.305	-.412	-.512	-.560	-.683	-.814	-1.171	
16	.200	-.159	-.213	-.279	-.345	-.393	-.475	-.572	-.520	
17	.300	-.112	-.165	-.207	-.271	-.303	-.315	-.326	-.299	
18	.500	-.111	-.139	-.115	-.117	-.133	-.170	-.156	******	
19	.650	-.060	-.027	-.052	-.084	-.096	-.108	-.092	-.110	
20	.780	-.062	-.057	-.065	-.075	-.092	-.094	-.067	-.055	
21	.900	-.040	-.044	-.045	-.043	-.055	-.065	-.069	-.057	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.737	-1.623	-1.583	******	-.242	-.090	-.105	-.243	-.563	-.348
2	.025	1.124	1.157	1.045	.837	.427	-.009	-.407	-.859	-1.033	-1.021
3	.050	.932	.997	.845	.621	.340	-.052	-.324	-.628	-.727	-.676
4	.100	.634	.726	.608	.413	.177	-.074	-.239	-.428	-.469	-.415
5	.150	.533	.580	.449	.277	.098	-.107	-.203	-.328	-.392	-.336
6	.200	.434	.494	.335	.191	.012	******	-.172	-.271	-.252	-.296
7	.250	.352	.420	.295	.124	-.042	-.137	-.164	-.234	-.207	-.150
8	.300	.317	.352	.279	.084	-.054	-.135	-.144	-.132	-.108	******
9	.400	.231	******	.129	.019	-.102	-.139	******	******	-.094	******
10	.500	.176	******	.055	******	******	-.156	******	-.068	-.079	-.054
11	.650	******	.122	.011	-.082	-.178	-.154	-.085	-.015	-.017	-.031
12	.780	.012	.043	-.025	-.131	-.165	-.163	-.076	.005	-.003	-.034
13	.900	-.060	-.033	-.085	-.153	-.216	-.164	-.102	-.035	-.040	-.041
14	.050	-1.664	-1.641	-1.541	-1.393	-.614	-.192	.087	.419	.519	.512
15	.100	-1.802	-1.07	-.322	-.650	-.414	-.185	.016	.291	.408	.309
16	.200	-.591	-.616	-.559	-.432	-.264	-.141	-.027	.147	.235	.200
17	.300	-.440	-.443	-.394	-.296	-.209	-.128	-.049	.098	.149	.107
18	.500	-.228	-.235	-.191	-.157	-.122	-.098	-.050	.054	.065	.038
19	.650	******	-.143	-.137	-.117	-.099	-.074	-.052	[illegible]	.040	.027
20	.780	-.121	-.113	-.111	-.112	-.112	-.099	-.074	[illegible]	.005	-.011
21	.900	-.139	-.119	-.144	-.109	-.117	-.113	-.098	[illegible]	-.040	-.051

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.3.- CONTINUED

RUN 69 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.039	-.335	******	-.285	******	-.608	-.795	-.537	.283
2	.025	.347	.453	.535	.719	.763	.568	.977	.832	.382
3	.050	.244	.349	.442	.557	.564	.688	.761	.688	.432
4	.100	.149	.226	.339	.405	.452	.527	.551	.510	.390
5	.150	.109	.174	.235	.319	.396	.415	.443	.425	.354
6	.200	.074	.144	.194	.262	.297	.349	.359	.353	.319
7	.250	.056	.113	.157	.225	.254	.305	.315	.300	.278
8	.300	.037	.080	.121	.182	.207	.249	.267	.252	******
9	.400	.020	.058	.097	.145	.169	.187	.202	.194	******
10	.500	.012	.043	.079	.112	.129	.156	.159	.158	.153
11	.650	******	.020	.042	.072	.086	.135	.107	.079	.085
12	.780	-.024	.019	.036	.051	.071	.080	.047	.025	.043
13	.900	-.083	-.093	-.076	-.083	-.043	-.011	-.044	-.027	
14	.050	-.362	-.479	-.620	-.742	-.373	-1.031	-1.294	-.955	
15	.100	-.245	-.331	-.437	-.529	-.606	-.715	-.919	-1.138	
16	.200	-.158	-.214	-.287	-.363	-.420	-.502	-.570	-.700	
17	.300	-.112	-.164	-.214	-.280	-.314	-.332	-.359	-.343	
18	.500	-.115	-.141	-.116	-.123	-.142	-.185	-.172	******	
19	.650	-.001	-.024	-.055	-.089	-.166	-.120	-.116	-.115	
20	.780	-.062	-.093	-.057	-.083	-.098	-.105	-.088	-.062	
21	.900	-.039	-.043	-.047	-.045	-.063	-.075	-.166	-.051	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.889	-2.220	-2.035	******	-1.120	-.767	-1.333	-.982	-1.127	-.515
2	.025	1.179	1.231	1.224	1.004	.190	-1.119	-1.692	-1.724	-1.540	-1.245
3	.050	.968	1.073	1.141	.862	.078	-.895	-1.594	-1.294	-1.277	-.844
4	.100	.698	.821	.851	.565	-.279	-.717	-.674	-.809	-.742	-.541
5	.150	.554	.672	.655	.403	-.349	-.691	-.425	-.548	-.530	-.452
6	.200	.457	.570	.533	.262	-.434	******	-.351	-.439	-.397	-.308
7	.250	.378	.459	.433	.183	-.504	-.648	-.282	-.347	-.340	-.236
8	.300	.330	.393	.354	.130	-.467	-.649	-.233	-.280	-.283	******
9	.400	.242	******	.220	.037	-.496	-.644	******	******	-.157	******
10	.500	.172	******	.133	******	******	-.693	******	-.115	-.141	-.126
11	.650	******	.096	.041	-.091	-.439	-.641	-.202	-.017	-.055	-.094
12	.780	.000	-.007	-.050	-.141	-.375	-.578	-.290	.019	-.024	-.096
13	.900	-.121	-.133	-.137	-.226	-.393	-.540	-.325	-.045	-.062	-.097
14	.050	-1.478	-1.363	-1.127	-.815	-.743	.148	.677	.750	.722	.503
15	.100	-.954	-1.014	-.915	-.659	-.491	.234	.420	.570	.575	.442
16	.200	-.567	-.772	-.589	-.593	-.351	-.052	.179	.335	.343	.252
17	.300	-.473	-.530	-.530	-.541	-.373	-.155	.043	.225	.231	.149
18	.500	-.292	-.385	-.447	-.335	-.353	-.191	-.069	.083	.104	.053
19	.650	******	-.319	-.372	-.324	-.295	-.229	-.119	.047	.058	.034
20	.780	-.195	-.253	-.263	-.326	-.314	-.282	-.159	-.014	.003	-.014
21	.900	-.242	-.272	-.325	-.253	-.271	-.268	-.241	-.065	-.052	-.055

TABLE A.3.- CONTINUED

RUN 73 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	-.020	-.022	******	-.054	******	-.028	-.060	-.091	-.020
2	.025	-.193	-.242	-.244	-.280	-.293	-.252	-.246	-.197	-.077
3	.050	-.128	-.156	-.172	-.254	-.250	-.231	-.243	-.215	-.066
4	.100	-.100	-.128	-.130	-.139	-.161	-.139	-.140	-.126	-.085
5	.150	-.067	-.094	-.112	-.100	-.116	-.118	-.100	-.093	-.080
6	.200	-.046	-.075	-.092	-.100	-.067	-.080	-.091	-.097	-.064
7	.250	-.038	-.059	-.069	-.069	-.072	-.079	-.079	-.081	-.062
8	.300	-.035	-.052	-.071	-.059	-.058	-.069	-.067	-.071	******
9	.400	-.027	-.050	-.047	-.060	-.052	-.055	-.054	-.051	******
10	.500	-.024	-.029	-.040	-.046	-.047	-.046	-.043	-.025	-.029
11	.650	******	-.024	-.031	-.031	-.028	-.028	.005	-.013	-.016
12	.700	.045	.018	.023	.026	.027	.024	.014	-.008	-.012
13	.900	-.005	.009	-.018	-.015	-.020	-.024	-.006	.000	
14	.050	.119	.162	.195	.189	.193	.163	.217	.208	
15	.100	.090	.125	.134	.147	.119	.155	.152	.155	
16	.200	.045	.077	.097	.099	.130	.103	.102	.139	
17	.300	.027	.046	.066	.076	.073	.078	.085	.069	
18	.500	.022	.033	.037	.045	.047	.041	.045	******	
19	.650	.024	.033	.039	.034	.037	.043	.034	.019	
20	.700	-.023	-.012	.009	.024	.034	.018	.001	.005	
21	.900	-.029	-.017	-.035	-.047	-.052	-.036	-.007	-.001	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-.043	-.022	-.033	******	-.042	-.046	-.010	-.020	-.006	.003
2	.025	-.333	-.315	-.305	-.273	-.322	-.306	-.251	-.247	-.243	-.157
3	.050	-.191	-.195	-.193	-.224	-.210	-.204	-.209	-.235	-.202	-.099
4	.100	-.146	-.155	-.133	-.144	-.152	-.145	-.124	-.142	-.113	-.085
5	.150	-.125	-.115	-.082	-.102	-.119	-.133	-.119	-.097	-.099	-.072
6	.200	-.113	-.094	-.104	-.107	-.079	******	-.083	-.077	-.075	-.045
7	.250	-.066	-.077	-.079	-.073	-.076	-.086	-.074	-.061	-.069	-.053
8	.300	-.061	-.071	-.063	-.057	-.077	-.065	-.070	-.048	-.045	******
9	.400	-.064	******	-.051	-.061	-.052	-.048	******	******	-.043	******
10	.500	-.042	******	-.034	******	******	-.031	******	-.037	-.032	-.023
11	.550	******	-.002	-.012	-.007	-.015	-.003	-.016	-.025	-.019	.001
12	.700	-.002	[illegible]	[illegible]	.010	.015	.023	.010	.020	.019	.003
13	.900	-.005	-.022	-.028	-.029	-.028	-.025	-.017	-.017	-.016	-.001
14	.050	.244	.237	.143	.203	.201	.186	.179	.196	.162	.123
15	.100	.186	.143	.135	.144	.150	.119	.167	.123	.123	.037
16	.200	.093	.093	.083	.092	.105	.093	.096	.065	.083	.055
17	.300	.055	.057	.071	.056	.065	.064	.072	.069	.037	.020
18	.500	.042	.037	.035	.041	.045	.044	.037	.034	.029	.016
19	.650	******	.045	.042	.034	.030	.033	.032	.033	.027	.022
20	.700	.024	.017	.023	.022	.023	.021	.011	.008	.010	-.003
21	.900	-.011	-.016	-.013	-.040	-.045	-.030	-.028	-.028	-.015	-.019

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.3.- CONTINUED

RUN 71 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.332	-.517	******	-.320	******	-.859	-.944	-1.256	-.081
2	.025	-.624	-1.102	-1.292	-1.302	-1.369	-1.357	-1.406	-1.136	-.363
3	.050	-.556	-.749	-.843	-.977	-1.014	-1.003	-1.038	1.004	-.337
4	.100	-.366	-.527	-.533	-.682	-.655	-.681	-.670	-.548	-.364
5	.150	-.270	-.399	-.483	-.545	-.542	-.573	-.483	-.414	-.315
6	.200	-.214	-.336	-.432	-.424	-.456	-.429	-.389	-.348	-.273
7	.250	-.193	-.275	-.339	-.337	-.343	-.339	-.342	-.310	-.257
8	.300	-.177	-.217	-.247	-.265	-.271	-.284	-.274	-.253	******
9	.400	-.079	-.152	-.197	-.193	-.185	-.210	-.192	-.192	******
10	.500	-.081	-.120	-.161	-.179	-.162	-.178	-.164	-.154	-.148
11	.550	******	-.061	-.093	-.112	-.111	-.106	-.078	-.095	-.099
12	.780	-.014	-.014	-.038	-.048	-.032	-.053	-.045	-.057	-.055
13	.900	-.057	-.040	-.075	-.094	-.094	-.079	-.055	-.020	
14	.050	.481	.670	.673	.713	.707	.734	.750	.630	
15	.100	.331	.499	.530	.548	.533	.571	.614	.698	
16	.200	.186	.303	.354	.365	.390	.380	.399	.450	
17	.300	.123	.215	.262	.297	.285	.300	.312	.306	
18	.500	.078	.131	.173	.195	.197	.185	.188	******	
19	.550	.063	.104	.135	.145	.150	.149	.136	.109	
20	.780	[illegible]	.046	.088	.112	.118	.105	.073	.049	
21	.900	-.045	-.019	.014	.031	.033	.035	-.017	-.005	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-.721	-.911	-.911	******	-.630	-.613	-.537	-.455	-.468	-.205
2	.025	-1.414	-1.352	-1.381	-1.336	-1.314	-1.385	-1.344	-1.214	-1.044	-.813
3	.050	-1.058	-.995	-.955	-.951	-1.002	-.995	-.954	-.856	-.765	-.538
4	.100	-.866	-.775	-.745	-.749	-.721	-.694	-.647	-.591	-.501	-.339
5	.150	-.486	-.491	-.502	-.512	-.503	-.518	-.513	-.462	-.390	-.251
6	.200	-.397	-.386	-.380	-.392	-.390	******	-.370	-.384	-.328	-.234
7	.250	-.306	-.247	-.341	-.345	-.332	-.317	-.315	-.274	-.273	-.193
8	.300	-.263	-.316	-.287	-.271	-.284	-.272	-.280	-.235	-.214	******
9	.400	-.193	******	-.203	-.201	-.195	-.186	******	******	-.114	******
10	.500	-.179	******	-.181	******	******	-.166	******	-.155	-.127	-.070
11	.550	******	-.097	-.101	-.099	-.098	-.093	-.091	-.074	-.057	-.048
12	.700	-.064	-.074	-.071	-.068	-.063	-.053	-.055	-.045	-.033	-.044
13	.900	-.062	-.075	-.065	-.065	-.062	-.083	-.073	-.072	-.063	-.047
14	.050	.792	.711	.693	.721	.710	.723	.690	.636	.570	.450
15	.100	.622	.563	.515	.561	.530	.498	.540	.556	.473	.337
16	.200	.414	.394	.373	.359	.373	.368	.348	.323	.299	.208
17	.300	.309	.284	.277	.287	.295	.279	.257	.245	.233	.127
18	.500	.192	.190	.184	.188	.192	.175	.163	.146	.119	.067
19	.550	******	.151	.147	.143	.142	.138	.127	.113	.097	.061
20	.700	.075	.101	.105	.103	.102	.095	.089	.079	.065	.023
21	.900	-.002	.034	.010	.025	.025	.026	.022	-.003	-.022	-.042

TABLE A.3.- CONTINUED

RUN 72 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-.924	-1.346	******	-1.731	******	-1.732	-1.995	-2.830	-.209
2	.025	-1.317	-1.665	-2.094	-2.039	-2.128	-2.384	-2.420	-2.156	-.617
3	.050	-.879	-1.404	-1.483	-1.703	-1.763	-1.498	-1.444	-1.201	-.595
4	.100	-.582	-.757	-.945	-.918	-.994	-.992	-.953	-.828	-.570
5	.150	-.418	-.597	-.721	-.710	-.775	-.752	-.729	-.637	-.500
6	.200	-.298	-.453	-.540	-.587	-.514	-.601	-.571	-.514	-.424
7	.250	-.246	-.379	-.449	-.486	-.493	-.483	-.471	-.437	-.376
8	.300	-.192	-.293	-.353	-.366	-.338	-.398	-.371	-.342	******
9	.400	-.145	-.212	-.253	-.277	-.274	-.282	-.260	-.257	******
10	.500	-.136	-.167	-.203	-.222	-.226	-.217	-.193	-.192	-.202
11	.650	******	-.085	-.133	-.120	-.120	-.109	-.080	-.102	-.124
12	.780	-.049	-.017	-.024	-.030	-.033	-.031	-.027	-.009	-.087
13	.900	-.092	-.038	-.051	-.075	-.061	-.038	-.053	-.040	
14	.050	.684	.832	.909	.953	.963	.958	1.017	1.074	
15	.100	.493	.598	.742	.764	.765	.772	.841	.838	
16	.200	.295	.433	.498	.533	.538	.539	.562	.640	
17	.300	.205	.319	.377	.397	.410	.423	.442	.437	
18	.500	.110	.177	.225	.243	.252	.252	.259	******	
19	.650	.079	.131	.167	.177	.180	.177	.169	.143	
20	.780	.004	.054	.085	.102	.101	.087	.083	.053	
21	.900	-.032	-.005	.015	.030	.020	.007	-.028	-.027	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.451	-2.105	-2.135	******	-1.427	-1.365	-1.349	-1.193	-1.065	-.600
2	.025	-2.272	-2.334	-2.115	-2.161	-2.138	-2.111	-2.087	-1.801	-1.599	-1.232
3	.050	-1.531	-1.409	-1.747	-1.673	-1.726	-1.693	-1.702	-1.435	-1.317	-.852
4	.100	-.980	-.960	-.960	-.957	-.948	-.946	-.956	-.728	-.774	-.570
5	.150	-.754	-.760	-.690	-.710	-.726	-.715	-.713	-.614	-.558	-.432
6	.200	-.571	-.595	-.530	-.568	-.587	******	-.557	-.472	-.426	-.303
7	.250	-.514	-.464	-.436	-.436	-.469	-.465	-.470	-.415	-.372	-.239
8	.300	-.375	-.424	-.415	-.399	-.405	-.396	-.396	-.352	-.309	******
9	.400	-.260	******	-.274	-.271	-.273	-.265	******	******	-.197	******
10	.500	-.207	******	-.229	******	******	-.214	******	-.199	-.172	-.131
11	.650	******	-.124	-.113	-.111	-.112	-.128	-.103	-.096	-.079	-.099
12	.780	-.048	-.049	-.054	-.053	-.046	-.039	-.055	-.039	-.042	-.094
13	.900	-.057	-.054	-.057	-.056	-.053	-.053	-.054	-.052	-.063	-.037
14	.050	1.044	.951	.936	.961	.949	.944	.931	.866	.800	.643
15	.100	.825	.772	.734	.762	.759	.737	.762	.711	.658	.536
16	.200	.596	.548	.535	.525	.551	.540	.517	.455	.432	.305
17	.300	.449	.417	.434	.436	.438	.435	.382	.360	.315	.201
18	.500	.261	.245	.245	.251	.243	.244	.232	.215	.186	.104
19	.650	******	.183	.178	.130	.169	.174	.166	.152	.125	.078
20	.780	.065	.063	.095	.094	.094	.093	.095	.086	.075	.026
21	.900	-.022	-.006	-.002	.020	.015	.017	.012	.001	-.002	-.023

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.3.- CONTINUED

RUN 73 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	-1.130	-1.732	******	-2.107	******	-2.174	-2.565	-3.426	-.221
2	.025	-1.493	-1.983	-2.435	-2.453	-2.446	-2.747	-2.681	-2.192	-.787
3	.050	-1.080	-1.443	-1.437	-2.036	-2.097	-1.604	-1.629	-1.384	-.708
4	.100	-.614	-.870	-1.037	-1.060	-1.090	-1.078	-1.077	-.930	-.631
5	.150	-.439	-.661	-.795	-.814	-.858	-.838	-.800	-.695	-.550
6	.200	-.336	-.511	-.597	-.544	-.659	-.668	-.630	-.552	-.471
7	.250	-.290	-.426	-.495	-.523	-.533	-.523	-.592	-.456	-.435
8	.300	-.219	-.323	-.389	-.416	-.423	-.424	-.391	-.354	******
9	.400	-.165	-.229	-.279	-.297	-.291	-.299	-.271	-.256	******
10	.500	-.151	-.176	-.213	-.230	-.236	-.221	-.197	-.179	-.207
11	.650	******	-.083	-.094	-.113	-.116	-.103	-.067	-.092	-.131
12	.780	-.065	-.015	-.017	-.021	-.027	-.021	-.024	-.053	-.093
13	.900	-.102	-.039	-.049	-.074	-.061	-.047	-.033	-.077	
14	.050	.760	.920	1.008	1.034	1.028	1.034	1.080	1.135	
15	.100	.546	.725	.805	.825	.819	.843	.891	.955	
16	.200	.536	.475	.539	.580	.585	.594	.615	.694	
17	.300	.221	.352	.411	.433	.445	.459	.485	.487	
18	.500	.121	.200	.247	.270	.271	.272	.280	******	
19	.650	.085	.141	.173	.186	.189	.185	.130	.153	
20	.780	.000	.051	.083	.095	.094	.081	.058	.050	
21	.900	-.034	-.011	.004	.020	.009	-.009	-.046	-.048	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-1.987	-2.576	-2.514	******	-1.739	-1.669	-1.541	-1.566	-1.421	-.773
2	.025	-2.492	-2.572	-2.403	-2.399	-2.456	-2.415	-2.453	-2.006	-1.950	-1.416
3	.050	-1.737	-1.961	-1.977	-1.930	-1.934	-1.975	-1.882	-1.746	-1.509	-.932
4	.100	-1.658	-1.082	-1.089	-1.092	-1.075	-1.056	-1.029	-.879	-.865	-.646
5	.150	-.813	-.844	-.815	-.814	-.809	-.811	-.778	-.710	-.627	-.453
6	.200	-.626	-.647	-.649	-.652	-.654	******	-.615	-.595	-.492	-.339
7	.250	-.534	-.540	-.525	-.531	-.534	-.513	-.518	-.461	-.409	-.275
8	.300	-.399	-.455	-.434	-.441	-.445	-.439	-.435	-.394	-.341	******
9	.400	-.275	******	-.298	-.294	-.290	-.284	******	******	-.213	******
10	.500	-.201	******	-.237	******	******	-.223	******	-.210	-.185	-.146
11	.650	******	-.135	-.111	-.112	-.112	-.108	-.104	-.100	-.085	-.114
12	.780	-.045	-.045	-.049	-.048	-.044	-.031	-.048	-.035	-.038	-.103
13	.900	-.086	-.059	-.057	-.058	-.056	-.059	-.053	-.049	-.061	-.091
14	.050	1.078	1.031	1.015	1.020	1.000	1.066	.993	.935	.869	.739
15	.100	.971	.829	.790	.813	.831	.805	.832	.791	.720	.555
16	.200	.546	.524	.592	.573	.580	.570	.562	.516	.470	.334
17	.300	.483	.451	.449	.448	.451	.440	.421	.396	.353	.227
18	.500	.282	.277	.272	.272	.272	.263	.255	.229	.199	.116
19	.650	******	.195	.192	.192	.187	.183	.180	.165	.135	.083
20	.780	.062	.089	.097	.094	.095	.095	.097	.086	.075	.023
21	.900	-.035	-.034	-.016	.012	.009	.011	.007	-.004	-.007	-.028

TABLE A.3.- CONCLUDED

RUN 74 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	-1.372	-1.973	******	-2.430	******	-2.363	-2.919	-3.959	-.156
2	.025	-1.592	-2.229	-2.732	-2.311	-2.897	-1.764	-2.729	-2.226	-.397
3	.050	-1.286	-1.950	-1.598	-1.862	-2.012	-1.769	-1.774	-1.551	-.793
4	.100	-.596	-.745	-1.123	-1.169	-1.197	-1.161	-1.133	-.981	-.677
5	.150	-.480	-.715	-.841	-.879	-.888	-.890	-.840	-.712	-.576
6	.200	-.364	-.537	-.633	-.684	-.771	-.692	-.645	-.569	-.491
7	.250	-.312	-.449	-.526	-.564	-.573	-.592	-.516	-.459	-.424
8	.300	-.242	-.545	-.415	-.444	-.452	-.440	-.387	-.346	******
9	.400	-.183	-.243	-.272	-.308	-.368	-.307	-.247	-.229	******
10	.500	-.156	-.153	-.217	-.235	-.232	-.217	-.161	-.143	-.236
11	.550	******	-.090	-.097	-.139	-.106	-.094	-.052	-.084	-.131
12	.760	-.073	-.012	-.011	-.016	-.021	-.023	-.073	-.112	-.113
13	.900	-.106	-.040	-.057	-.081	-.072	-.075	-.106	-.175	
14	.000	.824	.958	1.042	1.073	1.083	1.083	1.127	1.184	
15	.100	.599	.761	.855	.895	.831	.895	.957	1.010	
16	.200	.393	.515	.578	.613	.627	.636	.655	.730	
17	.300	.251	.363	.442	.474	.465	.494	.515	.516	
18	.500	.128	.216	.261	.288	.292	.286	.293	******	
19	.650	.069	.143	.184	.193	.197	.189	.183	.155	
20	.780	-.000	.054	.084	.094	.089	.073	.047	.037	
21	.900	-.037	-.026	-.015	.003	.000	-.021	-.054	-.051	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	-2.264	-2.970	-2.673	******	-2.383	-1.995	-1.923	-1.754	-1.667	-.946
2	.025	-2.643	-2.381	-2.757	-2.696	-2.763	-2.690	-2.553	-2.345	-2.214	-1.519
3	.050	-1.835	-1.877	-2.025	-2.010	-2.015	-2.027	-2.059	-2.009	-1.769	-1.106
4	.100	-1.162	-1.208	-1.191	-1.182	-1.163	-1.176	-1.145	-1.022	-.951	-.689
5	.150	-.840	-.959	-.883	-.902	-.884	-.873	-.851	-.774	-.693	-.492
6	.200	-.647	-.695	-.717	-.692	-.671	******	-.657	-.609	-.525	-.367
7	.250	-.549	-.578	-.574	-.572	-.570	-.562	-.555	-.475	-.445	-.330
8	.300	-.394	-.432	-.434	-.467	-.475	-.465	-.464	-.419	-.371	******
9	.400	-.268	******	-.312	-.307	-.311	-.307	******	******	-.234	******
10	.500	-.176	******	-.245	******	******	-.255	******	-.220	-.195	-.167
11	.650	******	-.150	-.110	-.111	-.115	-.108	-.105	-.098	-.086	-.124
12	.760	-.069	-.044	-.043	-.044	-.038	-.030	-.043	-.031	-.037	-.116
13	.900	-.150	-.176	-.065	-.053	-.058	-.061	-.055	-.052	-.062	-.099
14	.000	1.131	1.043	1.163	1.178	1.063	1.058	1.041	.997	.920	.751
15	.100	.948	.879	.844	.872	.893	.849	.875	.840	.779	.500
16	.200	.677	.642	.632	.621	.633	.629	.604	.553	.505	.366
17	.300	.514	.468	.434	.483	.466	.474	.456	.434	.379	.255
18	.500	.300	.290	.293	.295	.285	.284	.275	.251	.220	.122
19	.650	******	.219	.210	.200	.198	.199	.193	.173	.145	.038
20	.780	.052	.087	.099	.093	.098	.098	.099	.090	.076	.021
21	.900	-.055	-.041	-.023	.004	.001	.009	-.001	-.008	-.013	-.030

TABLE A.4.- STANDARD DEVIATIONS FOR PRESSURE COEFFICIENTS

RUN 50 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.046	.068	******	.112	******	.088	.115	.152	.008
2	.025	.022	.054	.037	.027	.067	.068	.082	.059	.037
3	.050	.029	.034	.037	.057	.041	.060	.033	.029	.029
4	.100	.003	.014	.031	.009	.030	.042	.030	.019	.024
5	.150	.024	.013	.029	.022	.009	.014	.018	.016	.010
6	.200	.005	.010	.019	.009	.013	.013	.010	.017	.009
7	.250	.007	.011	.008	.005	.008	.013	.010	.008	.004
8	.300	.006	.005	.008	.010	.006	.004	.008	.004	******
9	.400	.004	.008	.003	.005	.008	.008	.007	.007	******
10	.500	.007	.004	.005	.003	.006	.002	.004	.003	.005
11	.650	******	.002	.002	.001	.004	.002	.003	.002	.004
12	.780	.002	.002	.003	.004	.002	.002	.003	.004	.002
13	.900	.003	.004	.003	.002	.002	.005	.002	.004	
14	.050	.027	.014	.026	.024	.018	.014	.024	.015	
15	.100	.010	.015	.015	.020	.016	.006	.013	.015	
16	.200	.004	.007	.010	.009	.016	.019	.010	.012	
17	.300	.007	.009	.007	.005	.006	.012	.005	.015	
18	.500	.002	.003	.002	.003	.004	.005	.004	******	
19	.650	.001	.002	.002	.002	.004	.003	.004	.004	
20	.780	.004	.003	.002	.004	.010	.005	.003	.036	
21	.900	.003	.004	.006	.004	.007	.007	.004	.004	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.076	.105	.077	******	.072	.112	.025	.025	.047	.015
2	.025	.097	.041	.112	.059	.051	.053	.064	.034	.025	.007
3	.050	.028	.054	.049	.072	.082	.109	.086	.082	.076	.020
4	.100	.033	.031	.031	.009	.018	.006	.018	.083	.004	.021
5	.150	.021	.017	.012	.025	.040	.010	.014	.038	.019	.022
6	.200	.004	.012	.012	.012	.012	******	.009	.010	.014	.027
7	.250	.006	.008	.010	.013	.009	.015	.007	.014	.008	.009
8	.300	.008	.007	.007	.011	.005	.012	.005	.007	.013	******
9	.400	.003	******	.002	.006	.005	.004	******	******	.005	******
10	.500	.002	******	.005	******	******	.003	******	.002	.003	.005
11	.650	******	.004	.004	.004	.004	.002	.003	.003	.002	.004
12	.780	.005	.005	.005	.007	.004	.000	.003	.002	.003	.003
13	.900	.002	.003	.002	.004	.003	.003	.002	.004	.004	.002
14	.050	.010	.012	.016	.016	.011	.018	.023	.025	.019	.023
15	.100	.006	.009	.019	.018	.011	.031	.011	.023	.014	.021
16	.200	.013	.013	.012	.008	.015	.008	.008	.011	.002	.006
17	.300	.005	.007	.017	.011	.015	.010	.010	.005	.006	.007
18	.500	.009	.004	.006	.007	.005	.002	.010	.006	.003	.001
19	.650	******	.002	.003	.004	.003	.004	.002	.045	.004	.004
20	.780	.003	.003	.003	.001	.001	.004	.002	.004	.001	.004
21	.900	.005	.004	.002	.004	.003	.002	.002	.004	.002	.003

THE MAX STANDARD DEVIATION IS .15 OCCURRING AT I = 1 AND J = 8.

TABLE A.4.- CONTINUED

RUN 51 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.040	.068	******	.056	******	.025	.103	.115	.008
2	.025	.022	.043	.051	.077	.125	.100	.013	.022	.018
3	.050	.026	.055	.058	.073	.116	.059	.044	.075	.015
4	.100	.023	.018	.034	.014	.025	.012	.014	.013	.007
5	.150	.009	.012	.007	.016	.010	.012	.010	.015	.007
6	.200	.009	.011	.011	.009	.012	.011	.009	.013	.005
7	.250	.002	.005	.008	.013	.006	.004	.023	.012	.006
8	.300	.005	.005	.006	.009	.010	.002	.016	.007	******
9	.400	.004	.006	.003	.004	.003	.011	.013	.020	******
10	.500	.005	.002	.004	.004	.004	.009	.016	.020	.006
11	.650	******	.002	.002	.004	.009	.005	.007	.014	.005
12	.780	.004	.003	.004	.003	.004	.005	.023	.019	.003
13	.900	.004	.002	.003	.005	.005	.013	.018	.018	
14	.050	.014	.065	.009	.028	.037	.010	.005	.003	
15	.100	.017	.014	.009	.009	.014	.011	.009	.012	
16	.200	.011	.009	.010	.012	.011	.007	.010	.007	
17	.300	.004	.006	.004	.006	.011	.010	.008	.004	
18	.500	.003	.006	.001	.003	.006	.003	.002	******	
19	.650	.004	.004	.006	.004	.003	.001	.003	.003	
20	.780	.001	.002	.003	.003	.003	.004	.005	.010	
21	.900	.001	.002	.002	.004	.005	.006	.006	.009	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.079	.106	.350	******	.056	.031	.187	.097	.058	.035
2	.025	.033	.090	.061	.026	.078	.131	.077	.086	.099	.054
3	.050	.053	.049	.014	.052	.035	.041	.040	.049	.037	.056
4	.100	.019	.017	.034	.022	.034	.020	.015	.026	.016	.004
5	.150	.013	.019	.016	.016	.018	.015	.009	.011	.015	.017
6	.200	.004	.006	.019	.015	.014	******	.020	.013	.012	.016
7	.250	.016	.011	.005	.006	.005	.006	.011	.006	.007	.005
8	.300	.013	.006	.004	.006	.006	.010	.008	.010	.003	******
9	.400	.005	******	.004	.006	.002	.003	******	******	.002	******
10	.500	.012	******	.003	******	******	.004	******	.002	.002	.002
11	.650	******	.004	.002	.003	.004	.002	.004	.002	.002	.003
12	.780	.023	.003	.003	.004	.003	.003	.003	.002	.002	.002
13	.900	.004	.006	.004	.003	.002	.003	.003	.002	.001	.002
14	.050	.012	.005	.014	.009	.016	.014	.007	.011	.021	.019
15	.100	.011	.019	.011	.025	.005	.010	.011	.010	.017	.017
16	.200	.012	.002	.011	.006	.009	.012	.021	.007	.013	.006
17	.300	.006	.008	.004	.008	.009	.009	.006	.004	.008	.005
18	.500	.005	.005	.006	.003	.002	.003	.003	.002	.008	.006
19	.650	******	.003	.007	.003	.004	.005	.004	.005	.002	.001
20	.780	.007	.003	.003	.003	.003	.003	.001	.003	.002	.002
21	.900	.009	.004	.002	.002	.003	.001	.002	.004	.004	.003

THE MAX STANDARD DEVIATION IS .35 OCCURRING AT I = 1 AND J = 12.

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.4.- CONTINUED

RUN 53 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.031	.024	******	.061	******	.060	.112	.102	.014
2	.025	.033	.037	.045	.034	.044	.033	.026	.029	.018
3	.050	.020	.028	.027	.042	.031	.044	.025	.025	.017
4	.100	.016	.034	.030	.024	.024	.024	.015	.022	.015
5	.150	.017	.020	.022	.014	.022	.022	.015	.015	.015
6	.200	.012	.014	.017	.021	.016	.020	.014	.014	.011
7	.250	.014	.015	.017	.017	.016	.014	.012	.012	.008
8	.300	.010	.009	.014	.011	.014	.011	.015	.012	******
9	.400	.006	.006	.012	.010	.012	.006	.009	.009	******
10	.500	.006	.009	.008	.013	.009	.008	.007	.006	.005
11	.650	******	.011	.010	.010	.010	.005	.005	.007	.006
12	.780	.004	.003	.006	.005	.007	.006	.003	.003	.006
13	.900	.003	.005	.006	.008	.008	.006	.003	.004	
14	.050	.038	.053	.063	.052	.068	.075	.062	.080	
15	.100	.020	.037	.026	.038	.044	.048	.063	.054	
16	.200	.014	.020	.025	.027	.042	.028	.025	.031	
17	.300	.005	.015	.015	.020	.016	.010	.023	.016	
18	.500	.005	.007	.012	.010	.012	.009	.006	******	
19	.650	.006	.007	.009	.008	.010	.008	.003	.005	
20	.780	.005	.006	.006	.006	.008	.008	.005	.006	
21	.900	.003	.004	.003	.003	.006	.006	.009	.007	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.109	.314	.308	******	.220	.129	.300	.085	.062	.039
2	.025	.027	.039	.027	.071	.125	.191	.133	.062	.047	.042
3	.050	.022	.036	.027	.064	.138	.191	.167	.079	.046	.030
4	.100	.019	.019	.025	.107	.137	.102	.062	.042	.023	.036
5	.150	.015	.017	.021	.104	.137	.105	.028	.033	.022	.024
6	.200	.012	.013	.010	.078	.082	******	.017	.026	.015	.018
7	.250	.010	.015	.020	.077	.096	.084	.023	.018	.013	.009
8	.300	.009	.013	.029	.051	.089	.096	.021	.014	.011	******
9	.400	.008	******	.016	.052	.098	.077	******	******	.009	******
10	.500	.008	******	.011	******	******	.089	******	.013	.009	.006
11	.650	******	.016	.015	.035	.061	.069	.055	.008	.007	.007
12	.780	.009	.026	.031	.031	.047	.063	.093	.010	.007	.025
13	.900	.014	.046	.050	.029	.042	.054	.065	.006	.007	.005
14	.050	.035	.321	.535	.417	.165	.112	.048	.019	.013	.022
15	.100	.033	.139	.242	.158	.088	.077	.034	.016	.011	.013
16	.200	.020	.038	.132	.074	.051	.049	.020	.013	.009	.011
17	.300	.013	.065	.068	.108	.085	.071	.031	.008	.008	.008
18	.500	.019	.093	.131	.153	.121	.084	.044	.007	.005	.006
19	.650	******	.116	.122	.117	.111	.075	.034	.009	.004	.004
20	.780	.020	.104	.134	.115	.105	.076	.043	.009	.007	.007
21	.900	.026	.104	.114	.088	.072	.045	.037	.011	.005	.004

THE MAX STANDARD DEVIATION IS .53 OCCURRING AT I = 14 AND J = 12.

TABLE A.4.- CONTINUED

RUN 54   STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.009	.012	******	.055	******	.080	.075	.116	.013
2	.025	.020	.023	.047	.036	.041	.028	.024	.023	.022
3	.050	.019	.031	.027	.038	.024	.035	.041	.027	.019
4	.100	.019	.020	.018	.019	.018	.032	.017	.013	.021
5	.150	.012	.019	.021	.019	.022	.020	.018	.018	.018
6	.200	.012	.017	.019	.011	.015	.012	.016	.014	.015
7	.250	.010	.015	.015	.023	.015	.014	.012	.017	.013
8	.300	.007	.011	.013	.014	.011	.011	.015	.013	******
9	.400	.004	.007	.007	.012	.012	.008	.010	.011	******
10	.500	.003	.008	.011	.008	.010	.007	.009	.007	.009
11	.650	******	.016	.007	.005	.004	.005	.007	.006	.005
12	.780	.003	.006	.006	.006	.006	.006	.003	.004	.006
13	.900	.002	.004	.005	.006	.008	.003	.004	.003	
14	.050	.035	.048	.063	.059	.077	.040	.070	.257	
15	.100	.015	.023	.039	.040	.042	.028	.050	.139	
16	.200	.013	.015	.022	.032	.024	.035	.024	.025	
17	.300	.008	.012	.015	.021	.020	.008	.030	.021	
18	.500	.008	.007	.011	.010	.012	.011	.009	******	
19	.650	.007	.007	.011	.007	.006	.007	.007	.006	
20	.780	.005	.004	.003	.005	.007	.003	.005	.004	
21	.900	.003	.003	.004	.005	.005	.007	.015	.006	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.155	.266	.490	******	.069	.023	.013	.024	.046	.031
2	.025	.031	.033	.083	.086	.070	.052	.035	.029	.045	.039
3	.050	.020	.047	.070	.052	.064	.056	.056	.029	.025	.025
4	.100	.025	.037	.048	.041	.042	.024	.022	.025	.022	.019
5	.150	.023	.028	.030	.042	.028	.018	.019	.018	.014	.020
6	.200	.017	.030	.051	.037	.014	******	.013	.014	.008	.012
7	.250	.020	.029	.041	.024	.013	.012	.009	.012	.007	.007
8	.300	.016	.023	.030	.029	.019	.020	.007	.010	.009	******
9	.400	.012	******	.022	.023	.015	.018	******	******	.004	******
10	.500	.009	******	.018	******	******	.024	******	.006	.004	.004
11	.650	******	.006	.014	.012	.020	.019	.016	.005	.004	.003
12	.780	.005	.007	.012	.012	.019	.015	.014	.007	.001	.005
13	.900	.004	.004	.009	.018	.013	.031	.013	.004	.003	.004
14	.050	.107	.242	.261	.168	.102	.041	.024	.020	.020	.019
15	.100	.046	.076	.038	.068	.052	.041	.025	.015	.015	.012
16	.200	.029	.042	.055	.031	.031	.017	.013	.009	.008	.010
17	.300	.014	.021	.026	.020	.022	.016	.013	.009	.010	.006
18	.500	.007	.007	.013	.013	.012	.009	.012	.005	.004	.003
19	.650	******	.005	.007	.011	.012	.012	.007	.004	.004	.003
20	.780	.006	.036	.004	.007	.008	.010	.009	.004	.005	.006
21	.900	.006	.004	.005	.007	.011	.016	.010	.005	.002	.003

THE MAX STANDARD DEVIATION IS .49 OCCURRING AT I = 1 AND J = 12.

TABLE A.4.- CONTINUED

RUN 56 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.099	.101	******	.093	******	.068	.105	.117	.065
2	.025	.029	.049	.041	.053	.054	.050	.033	.037	.018
3	.050	.028	.030	.031	.028	.031	.023	.030	.019	.014
4	.100	.024	.022	.031	.020	.024	.020	.021	.015	.016
5	.150	.012	.020	.024	.022	.027	.015	.015	.017	.011
6	.200	.009	.013	.017	.020	.017	.013	.010	.011	.007
7	.250	.010	.017	.018	.021	.018	.009	.010	.008	.006
8	.300	.008	.010	.009	.014	.016	.011	.014	.010	******
9	.400	.005	.010	.011	.010	.010	.010	.011	.008	******
10	.500	.005	.007	.011	.011	.008	.007	.008	.008	.006
11	.650	******	.013	.008	.007	.007	.004	.010	.007	.008
12	.780	.003	.006	.006	.006	.006	.010	.022	.011	.005
13	.900	.003	.006	.004	.007	.009	.007	.032	.026	
14	.050	.032	.041	.065	.054	.078	.044	.187	.288	
15	.100	.018	.037	.034	.033	.032	.050	.144	.340	
16	.200	.015	.013	.026	.030	.027	.026	.126	.213	
17	.300	.009	.013	.017	.023	.016	.011	.024	.053	
18	.500	.007	.005	.014	.011	.012	.012	.055	******	
19	.650	.006	.009	.011	.010	.010	.009	.072	.075	
20	.780	.005	.007	.007	.007	.007	.013	.085	.081	
21	.900	.004	.004	.004	.004	.005	.011	.038	.074	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.163	.213	.198	******	.170	.488	.304	.066	.085	.098
2	.025	.051	.052	.066	.150	.282	.666	.761	.228	.236	.158
3	.050	.024	.016	.047	.166	.129	.165	.205	.070	.077	.024
4	.100	.019	.017	.041	.181	.084	.102	.043	.028	.027	.040
5	.150	.015	.015	.044	.131	.083	.105	.146	.033	.025	.016
6	.200	.008	.008	.028	.150	.075	******	.149	.021	.013	.020
7	.250	.009	.010	.035	.117	.144	.152	.126	.022	.016	.015
8	.300	.006	.013	.034	.119	.087	.101	.091	.020	.011	******
9	.400	.005	******	.030	.083	.093	.117	******	******	.014	******
10	.500	.005	******	.025	******	******	.098	******	.020	.014	.008
11	.650	******	.017	.031	.041	.089	.089	.063	.027	.014	.009
12	.780	.011	.024	.027	.043	.071	.068	.037	.028	.008	.008
13	.900	.013	.022	.039	.031	.035	.064	.038	.018	.008	.007
14	.050	.103	.136	.156	.171	.113	.083	.036	.017	.018	.016
15	.100	.158	.106	.090	.174	.073	.081	.023	.009	.014	.011
16	.200	.108	.059	.107	.083	.070	.062	.015	.009	.011	.013
17	.300	.085	.040	.102	.089	.049	.053	.019	.008	.010	.008
18	.500	.042	.046	.035	.041	.039	.063	.030	.006	.006	.006
19	.650	******	.058	.052	.057	.028	.072	.034	.009	.007	.006
20	.780	.063	.067	.085	.064	.093	.069	.036	.007	.011	.008
21	.900	.054	.068	.067	.081	.077	.056	.032	.011	.005	.006

THE MAX STANDARD DEVIATION IS .76 OCCURRING AT I = 2 AND J = 16.

TABLE A.4.- CONTINUED

RUN 57 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.669	.640	******	.425	******	.107	.298	.446	.744
2	.025	.206	.278	.262	.364	.356	.319	.301	.179	.684
3	.050	.024	.029	.032	.033	.039	.033	.023	.019	.018
4	.100	.022	.031	.026	.029	.023	.030	.019	.009	.016
5	.150	.014	.018	.019	.019	.029	.014	.012	.016	.020
6	.200	.011	.010	.022	.020	.019	.013	.010	.009	.011
7	.250	.009	.013	.015	.019	.018	.016	.010	.008	.007
8	.300	.005	.010	.015	.015	.017	.011	.009	.008	******
9	.400	.008	.008	.011	.010	.012	.010	.007	.006	******
10	.500	.005	.006	.009	.011	.009	.008	.008	.006	.005
11	.650	******	.008	.009	.020	.023	.029	.019	.010	.010
12	.780	.006	.006	.009	.006	.007	.005	.004	.004	.007
13	.900	.003	.005	.006	.005	.009	.007	.003	.003	
14	.050	.034	.043	.048	.060	.062	.067	.149	.042	
15	.100	.023	.020	.042	.050	.050	.042	.051	.045	
16	.200	.012	.019	.016	.019	.033	.028	.034	.117	
17	.300	.008	.008	.017	.021	.021	.007	.009	.011	
18	.500	.007	.008	.013	.010	.013	.013	.009	******	
19	.650	.007	.007	.011	.007	.007	.007	.013	.006	
20	.780	.007	.006	.009	.006	.005	.006	.010	.008	
21	.900	.003	.003	.004	.005	.006	.005	.008	.008	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.652	1.203	.638	******	.559	.499	1.197	.604	.540	.108
2	.025	.313	.420	.402	.320	.152	1.591	1.106	1.777	1.656	1.293
3	.050	.027	.015	.027	.038	.132	.197	.309	.111	.053	.028
4	.100	.026	.016	.022	.045	.154	.081	.072	.067	.031	.041
5	.150	.019	.013	.024	.034	.075	.115	.071	.033	.025	.022
6	.200	.010	.012	.018	.031	.147	******	.157	.028	.022	.014
7	.250	.010	.010	.022	.028	.109	.082	.152	.022	.019	.014
8	.300	.007	.010	.017	.034	.106	.093	.140	.030	.018	******
9	.400	.008	******	.020	.023	.089	.097	******	******	.014	******
10	.500	.006	******	.023	******	******	.086	******	.050	.015	.010
11	.650	******	.017	.023	.031	.052	.113	.069	.046	.015	.010
12	.780	.020	.023	.032	.033	.037	.081	.087	.050	.012	.012
13	.900	.029	.025	.047	.034	.041	.040	.047	.031	.017	.009
14	.050	.172	.339	.210	.102	.075	.110	.067	.022	.016	.012
15	.100	.195	.067	.155	.223	.097	.064	.062	.015	.016	.010
16	.200	.166	.025	.134	.132	.101	.048	.053	.007	.008	.010
17	.300	.095	.020	.082	.098	.080	.051	.054	.009	.007	.008
18	.500	.050	.033	.034	.052	.024	.060	.052	.015	.006	.007
19	.650	******	.046	.054	.055	.095	.084	.082	.015	.009	.007
20	.780	.094	.051	.112	.071	.073	.078	.071	.010	.025	.021
21	.900	.087	.052	.069	.107	.066	.079	.057	.023	.013	.010

THE MAX STANDARD DEVIATION IS 1.78 OCCURRING AT I = 2 AND J = 17.

TABLE A.4.- CONTINUED

RUN 58 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.015	.019	******	.046	******	.051	.102	.095	.026
2	.025	.033	.053	.048	.033	.050	.026	.025	.031	.012
3	.050	.028	.032	.027	.042	.034	.032	.026	.027	.016
4	.100	.017	.024	.028	.021	.024	.024	.016	.011	.008
5	.150	.012	.023	.032	.023	.018	.014	.012	.012	.011
6	.200	.014	.013	.021	.024	.018	.015	.015	.009	.006
7	.250	.008	.017	.022	.023	.014	.014	.011	.010	.008
8	.300	.008	.012	.014	.015	.012	.010	.009	.009	******
9	.400	.006	.008	.009	.012	.010	.006	.010	.005	******
10	.500	.004	.007	.007	.007	.008	.005	.007	.003	.005
11	.650	******	.019	.005	.008	.006	.007	.005	.005	.007
12	.780	.004	.007	.006	.004	.006	.005	.014	.009	.007
13	.900	.005	.005	.005	.006	.007	.006	.023	.010	
14	.050	.031	.042	.080	.077	.087	.055	.141	.182	
15	.100	.019	.029	.032	.034	.038	.037	.164	.279	
16	.200	.010	.015	.019	.027	.020	.027	.041	.147	
17	.300	.007	.012	.016	.021	.019	.007	.020	.060	
18	.500	.006	.009	.011	.011	.014	.012	.068	******	
19	.650	.005	.010	.010	.008	.012	.009	.033	.010	
20	.780	.006	.007	.005	.005	.006	.008	.066	.089	
21	.900	.003	.004	.005	.005	.004	.007	.062	.057	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.123	.166	.191	******	.179	.311	.562	.096	.094	.055
2	.025	.024	.018	.011	.083	.247	.611	.845	.077	.089	.050
3	.050	.018	.013	.013	.083	.220	.271	.558	.119	.087	.046
4	.100	.012	.011	.021	.075	.176	.117	.148	.044	.027	.036
5	.150	.011	.010	.016	.058	.122	.062	.063	.032	.040	.019
6	.200	.009	.009	.014	.074	.098	******	.071	.020	.022	.013
7	.250	.006	.008	.027	.072	.152	.163	.066	.017	.014	.015
8	.300	.006	.007	.022	.044	.136	.118	.153	.019	.010	******
9	.400	.006	******	.014	.079	.094	.145	******	******	.008	******
10	.500	.006	******	.017	******	******	.099	******	.008	.005	.008
11	.650	******	.013	.020	.039	.049	.051	.074	.007	.004	.006
12	.780	.015	.013	.017	.030	.064	.062	.043	.007	.003	.006
13	.900	.024	.023	.018	.014	.029	.041	.060	.011	.003	.004
14	.050	.143	.236	.111	.110	.178	.130	.049	.027	.020	.019
15	.100	.119	.095	.099	.093	.054	.125	.050	.020	.017	.027
16	.200	.108	.068	.048	.076	.102	.114	.051	.012	.014	.010
17	.300	.039	.046	.054	.113	.075	.102	.047	.011	.010	.009
18	.500	.055	.040	.049	.061	.078	.070	.028	.006	.004	.004
19	.650	******	.039	.035	.049	.104	.059	.019	.009	.003	.003
20	.780	.070	.043	.035	.035	.074	.044	.027	.006	.008	.006
21	.900	.074	.040	.035	.051	.058	.048	.041	.015	.006	.003

THE MAX STANDARD DEVIATION IS .85 OCCURRING AT I = 2 AND J = 16.

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE A.4.- CONTINUED

RUN 59   STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.015	.018	******	.032	******	.066	.069	.047	.015
2	.025	.030	.023	.034	.048	.058	.046	.045	.042	.023
3	.050	.024	.032	.041	.033	.034	.033	.034	.036	.027
4	.100	.014	.030	.034	.034	.035	.028	.029	.025	.019
5	.150	.009	.017	.020	.016	.022	.023	.022	.023	.018
6	.200	.011	.013	.017	.021	.018	.026	.023	.025	.014
7	.250	.008	.012	.016	.016	.017	.012	.016	.017	.014
8	.300	.007	.010	.013	.014	.013	.016	.012	.014	******
9	.400	.006	.009	.010	.014	.013	.011	.012	.012	******
10	.500	.003	.004	.007	.012	.012	.011	.008	.010	.007
11	.650	******	.006	.008	.007	.009	.008	.007	.005	.007
12	.780	.005	.005	.005	.007	.007	.007	.004	.003	.003
13	.900	.010	.004	.008	.004	.006	.005	.003	.004	
14	.050	.026	.036	.042	.064	.074	.062	.058	.036	
15	.100	.023	.030	.025	.041	.030	.040	.043	.086	
16	.200	.010	.013	.013	.021	.033	.033	.040	.024	
17	.300	.007	.009	.012	.019	.016	.021	.013	.015	
18	.500	.007	.010	.006	.012	.011	.014	.012	******	
19	.650	.004	.004	.009	.012	.012	.014	.005	.004	
20	.780	.003	.005	.005	.026	.008	.007	.005	.004	
21	.900	.003	.002	.004	.003	.007	.004	.008	.006	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.110	.120	.122	******	.089	.091	.146	.070	.083	.147
2	.025	.045	.034	.019	.017	.021	.015	.014	.014	.057	.125
3	.050	.033	.031	.024	.023	.022	.011	.010	.011	.099	.069
4	.100	.019	.023	.020	.020	.016	.014	.016	.020	.084	.056
5	.150	.022	.021	.016	.023	.015	.014	.010	.015	.082	.057
6	.200	.012	.012	.015	.012	.011	******	.009	.012	.061	.089
7	.250	.012	.019	.015	.009	.011	.008	.009	.012	.057	.075
8	.300	.011	.013	.009	.009	.009	.009	.013	.015	.070	******
9	.400	.011	******	.008	.006	.009	.010	******	******	.065	******
10	.500	.009	******	.006	******	******	.007	******	.017	.034	.070
11	.650	******	.007	.005	.004	.007	.009	.011	.028	.028	.037
12	.780	.004	.005	.005	.008	.010	.016	.018	.030	.029	.028
13	.900	.004	.004	.006	.008	.014	.023	.026	.050	.030	.031
14	.050	.058	.087	.118	.112	.081	.082	.225	.090	.067	.096
15	.100	.033	.047	.063	.031	.038	.027	.051	.135	.169	.051
16	.200	.037	.020	.020	.016	.023	.020	.062	.114	.076	.041
17	.300	.017	.019	.016	.013	.011	.022	.043	.097	.095	.035
18	.500	.008	.009	.007	.005	.012	.019	.021	.034	.036	.044
19	.650	******	.007	.006	.005	.014	.031	.023	.054	.025	.037
20	.780	.006	.006	.005	.007	.014	.034	.043	.030	.027	.098
21	.900	.007	.003	.006	.003	.021	.034	.045	.091	.058	.082

THE MAX STANDARD DEVIATION IS .22 OCCURRING AT I = 14 AND J = 16.

TABLE A.4.- CONTINUED

RUN 60 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.016	.015	******	.047	******	.068	.068	.058	.015
2	.025	.032	.045	.046	.051	.038	.035	.029	.025	.014
3	.050	.024	.034	.041	.034	.031	.026	.020	.016	.012
4	.100	.017	.025	.027	.027	.020	.026	.017	.009	.011
5	.150	.012	.020	.021	.028	.021	.014	.015	.013	.010
6	.200	.010	.017	.017	.020	.018	.020	.011	.010	.008
7	.250	.010	.013	.016	.020	.015	.015	.009	.009	.006
8	.300	.007	.010	.014	.016	.013	.011	.010	.007	******
9	.400	.004	.009	.010	.010	.011	.009	.005	.006	******
10	.500	.004	.007	.008	.009	.009	.008	.005	.004	.006
11	.650	******	.006	.008	.009	.007	.005	.005	.005	.007
12	.780	.009	.005	.006	.006	.007	.007	.011	.007	.008
13	.900	.006	.005	.005	.007	.008	.005	.016	.005	
14	.050	.028	.048	.044	.051	.077	.053	.077	.131	
15	.100	.022	.027	.037	.042	.042	.040	.084	.210	
16	.200	.011	.016	.025	.027	.029	.028	.022	.082	
17	.300	.009	.012	.019	.025	.015	.009	.013	.038	
18	.500	.010	.006	.012	.009	.014	.013	.040	******	
19	.650	.006	.009	.010	.010	.009	.007	.032	.031	
20	.780	.006	.008	.005	.005	.005	.029	.049	.035	
21	.900	.006	.005	.006	.005	.007	.009	.013	.015	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.170	.145	.158	******	.049	.238	.429	.091	.085	.045
2	.025	.024	.018	.012	.066	.275	.200	.510	.071	.061	.045
3	.050	.023	.016	.016	.102	.265	.161	.204	.075	.051	.034
4	.100	.018	.016	.018	.080	.186	.047	.088	.030	.027	.031
5	.150	.012	.013	.023	.050	.184	.083	.160	.035	.026	.015
6	.200	.010	.010	.020	.063	.149	******	.112	.031	.020	.012
7	.250	.007	.009	.019	.072	.170	.073	.126	.024	.017	.017
8	.300	.007	.010	.023	.068	.131	.093	.102	.026	.019	******
9	.400	.006	******	.022	.047	.091	.079	******	******	.011	******
10	.500	.006	******	.019	******	******	.063	******	.024	.016	.008
11	.650	******	.016	.024	.024	.079	.087	.045	.029	.015	.009
12	.780	.016	.023	.024	.026	.043	.091	.055	.028	.009	.012
13	.900	.026	.030	.045	.040	.028	.050	.067	.022	.013	.007
14	.050	.208	.175	.125	.090	.105	.132	.046	.017	.016	.017
15	.100	.127	.078	.163	.134	.097	.097	.033	.015	.012	.015
16	.200	.131	.039	.103	.079	.077	.056	.034	.009	.012	.009
17	.300	.057	.026	.084	.089	.059	.035	.046	.008	.008	.008
18	.500	.050	.031	.040	.026	.034	.060	.041	.007	.006	.005
19	.650	******	.047	.052	.044	.099	.071	.059	.012	.007	.005
20	.780	.081	.051	.084	.058	.079	.068	.056	.008	.009	.007
21	.900	.082	.065	.074	.083	.085	.067	.071	.014	.017	.014

THE MAX STANDARD DEVIATION IS .51 OCCURRING AT I = 2 AND J = 16.

RUN 61 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.023	.030	******	.068	******	.081	.044	.036	.008
2	.025	.035	.044	.038	.020	.026	.027	.020	.015	.013
3	.050	.024	.024	.027	.027	.020	.023	.021	.016	.013
4	.100	.017	.026	.027	.022	.018	.025	.018	.015	.007
5	.150	.013	.018	.023	.016	.020	.012	.011	.003	.010
6	.200	.013	.014	.018	.016	.011	.012	.009	.007	.007
7	.250	.013	.013	.013	.019	.017	.015	.015	.013	.011
8	.300	.006	.011	.013	.012	.011	.008	.008	.007	******
9	.400	.006	.010	.010	.038	.008	.008	.004	.004	******
10	.500	.004	.007	.010	.009	.008	.003	.004	.006	.005
11	.650	******	.005	.005	.007	.005	.006	.009	.007	.007
12	.780	.006	.009	.015	.020	.023	.016	.010	.006	.005
13	.900	.003	.009	.007	.004	.005	.011	.057	.020	
14	.050	.034	.040	.050	.047	.058	.089	.039	.024	
15	.100	.018	.035	.043	.039	.060	.020	.067	.016	
16	.200	.010	.015	.024	.030	.020	.019	.014	.015	
17	.300	.016	.020	.021	.018	.024	.019	.028	.028	
18	.500	.021	.013	.011	.010	.009	.006	.019	******	
19	.650	.005	.006	.007	.007	.004	.007	.016	.013	
20	.780	.006	.006	.003	.005	.003	.007	.023	.016	
21	.900	.003	.005	.007	.006	.003	.008	.030	.020	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.091	.339	.233	******	.055	.067	.094	.072	.058	.030
2	.025	.013	.328	.410	.091	.069	.071	.086	.045	.063	.039
3	.050	.019	.216	.315	.097	.060	.069	.076	.068	.060	.034
4	.100	.015	.041	.098	.074	.036	.029	.032	.049	.040	.016
5	.150	.029	.084	.040	.033	.018	.021	.025	.019	.030	.020
6	.200	.011	.079	.057	.027	.013	******	.016	.020	.019	.024
7	.250	.019	.063	.077	.023	.023	.024	.022	.020	.020	.012
8	.300	.011	.082	.088	.027	.020	.017	.020	.019	.021	******
9	.400	.012	******	.087	.011	.012	.014	******	******	.008	******
10	.500	.008	******	.112	******	******	.008	******	.026	.007	.007
11	.650	******	.123	.068	.051	.016	.014	.013	.006	.003	.005
12	.780	.008	.129	.066	.048	.030	.008	.012	.004	.005	.007
13	.900	.007	.078	.057	.061	.036	.017	.008	.005	.006	.005
14	.050	.060	.088	.027	.018	.017	.019	.016	.026	.025	.019
15	.100	.101	.101	.018	.014	.015	.019	.015	.023	.023	.020
16	.200	.034	.078	.017	.012	.011	.014	.016	.014	.012	.010
17	.300	.022	.096	.023	.018	.015	.019	.018	.016	.016	.016
18	.500	.019	.029	.011	.013	.011	.009	.010	.007	.006	.005
19	.650	******	.044	.012	.010	.012	.008	.008	.006	.005	.004
20	.780	.018	.026	.021	.018	.015	.010	.007	.005	.004	.002
21	.900	.008	.012	.017	.025	.024	.028	.034	.041	.042	.031

THE MAX STANDARD DEVIATION IS .41 OCCURRING AT I = 2 AND J = 12.

TABLE A.4.- CONTINUED

RUN 52 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.048	.049	******	.156	******	.113	.112	.185	.008
2	.025	.026	.017	.029	.263	.745	.104	.123	.030	.019
3	.050	.016	.014	.031	.196	.299	.032	.044	.063	.018
4	.100	.017	.018	.029	.111	.102	.046	.033	.034	.021
5	.150	.010	.012	.026	.098	.129	.026	.019	.022	.021
6	.200	.009	.011	.018	.083	.140	.011	.014	.017	.013
7	.250	.005	.012	.027	.097	.189	.015	.009	.013	.014
8	.300	.007	.008	.021	.076	.150	.016	.013	.010	******
9	.400	.004	.008	.022	.082	.172	.016	.010	.006	******
10	.500	.005	.009	.025	.079	.120	.025	.014	.012	.008
11	.650	******	.013	.026	.081	.051	.041	.015	.011	.008
12	.760	.036	.012	.026	.065	.052	.063	.012	.010	.008
13	.900	.004	.016	.063	.036	.041	.050	.021	.016	
14	.050	.024	.049	.010	.118	.022	.020	.015	.021	
15	.100	.023	.091	.159	.110	.020	.010	.017	.023	
16	.200	.014	.018	.069	.072	.022	.010	.013	.018	
17	.300	.010	.008	.034	.080	.033	.012	.009	.011	
18	.500	.005	.011	.078	.118	.041	.012	.007	******	
19	.650	.005	.016	.097	.130	.046	.012	.008	.006	
20	.780	.003	.017	.102	.118	.033	.018	.007	.007	
21	.900	.005	.012	.077	.076	.024	.010	.008	.005	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.078	.099	.181	******	.058	.063	.081	.053	.043	.022
2	.025	.103	.060	.090	.064	.106	.102	.089	.083	.079	.058
3	.050	.049	.089	.062	.042	.056	.066	.066	.073	.064	.032
4	.100	.048	.048	.084	.071	.053	.063	.042	.050	.023	.026
5	.150	.033	.032	.016	.029	.033	.038	.036	.035	.023	.011
6	.200	.020	.016	.019	.014	.010	******	.032	.033	.023	.017
7	.250	.013	.015	.021	.016	.014	.011	.012	.022	.022	.016
8	.300	.010	.018	.019	.018	.019	.005	.009	.016	.009	******
9	.400	.010	******	.011	.010	.014	.016	******	******	.009	******
10	.500	.006	******	.007	******	******	.008	******	.013	.007	.007
11	.650	******	.004	.004	.007	.006	.005	.009	.009	.006	.005
12	.780	.007	.007	.004	.003	.003	.006	.006	.005	.003	.005
13	.900	.017	.010	.005	.006	.007	.011	.006	.007	.004	.008
14	.050	.019	.025	.029	.029	.034	.030	.040	.039	.030	.024
15	.100	.031	.025	.026	.031	.034	.028	.032	.016	.031	.023
16	.200	.013	.019	.015	.016	.018	.020	.020	.016	.017	.015
17	.300	.018	.016	.010	.013	.018	.016	.018	.019	.012	.011
18	.500	.006	.006	.008	.007	.009	.010	.012	.010	.008	.006
19	.650	******	.005	.006	.007	.006	.010	.008	.007	.007	.004
20	.780	.006	.005	.003	.006	.009	.007	.007	.006	.006	.004
21	.900	.004	.003	.005	.016	.010	.007	.007	.008	.006	.007

THE MAX STANDARD DEVIATION IS .75 OCCURRING AT I = 2 AND J = 5.

TABLE A.4.- CONTINUED

RUN 63 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.013	.020	******	.032	******	.064	.092	.029	.014
2	.025	.031	.037	.041	.042	.054	.038	.031	.021	.018
3	.050	.032	.024	.033	.032	.033	.027	.020	.017	.018
4	.100	.010	.024	.022	.024	.020	.025	.020	.012	.010
5	.150	.011	.025	.021	.024	.025	.015	.015	.015	.010
6	.200	.009	.016	.032	.022	.020	.017	.016	.014	.008
7	.250	.010	.019	.020	.014	.016	.018	.010	.010	.008
8	.300	.009	.007	.017	.016	.024	.016	.012	.014	******
9	.400	.005	.011	.016	.011	.017	.011	.013	.006	******
10	.500	.004	.006	.008	.008	.006	.008	.009	.005	.004
11	.650	******	.006	.008	.007	.007	.007	.004	.004	.004
12	.780	.028	.006	.010	.006	.010	.007	.006	.010	.007
13	.900	.003	.003	.005	.007	.012	.007	.008	.006	
14	.050	.023	.050	.039	.051	.047	.053	.134	.029	
15	.100	.017	.036	.032	.047	.042	.044	.085	.224	
16	.200	.013	.016	.019	.019	.035	.022	.014	.154	
17	.300	.010	.011	.019	.020	.018	.014	.027	.043	
18	.500	.008	.006	.016	.012	.015	.019	.027	******	
19	.650	.006	.009	.009	.009	.009	.009	.016	.047	
20	.780	.003	.004	.005	.008	.007	.005	.017	.024	
21	.900	.005	.003	.004	.005	.004	.006	.056	.053	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.116	.199	.177	******	.151	.211	.628	.032	.098	.044
2	.025	.021	.017	.015	.108	.397	.395	.646	.052	.038	.057
3	.050	.016	.019	.020	.128	.244	.298	.486	.081	.068	.044
4	.100	.014	.013	.019	.127	.251	.080	.128	.037	.022	.024
5	.150	.015	.012	.029	.068	.166	.115	.161	.019	.020	.015
6	.200	.011	.010	.025	.098	.192	******	.200	.025	.015	.013
7	.250	.007	.007	.023	.081	.133	.122	.154	.020	.018	.011
8	.300	.010	.012	.026	.054	.135	.143	.171	.019	.016	******
9	.400	.022	******	.029	.044	.111	.157	******	******	.015	******
10	.500	.006	******	.025	******	******	.107	******	.027	.017	.010
11	.650	******	.017	.021	.026	.056	.150	.053	.028	.011	.008
12	.780	.008	.015	.024	.031	.065	.125	.033	.027	.008	.008
13	.900	.010	.032	.030	.027	.053	.102	.033	.018	.013	.007
14	.050	.049	.250	.113	.209	.275	.124	.027	.014	.016	.017
15	.100	.062	.118	.179	.192	.219	.120	.032	.012	.016	.013
16	.200	.038	.057	.119	.161	.242	.075	.041	.011	.008	.009
17	.300	.016	.035	.122	.135	.187	.052	.032	.007	.007	.008
18	.500	.023	.037	.033	.033	.053	.039	.039	.007	.005	.011
19	.650	******	.043	.044	.037	.058	.060	.056	.007	.005	.005
20	.780	.012	.055	.078	.049	.046	.067	.045	.006	.004	.006
21	.900	.019	.038	.052	.059	.053	.053	.077	.020	.028	.026

THE MAX STANDARD DEVIATION IS .85 OCCURRING AT I = 2 AND J = 16.

TABLE A.4.- CONTINUED

RUN 64 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.021	.029	******	.065	******	.244	.390	.083	.024
2	.025	.027	.035	.023	.034	.016	.015	.044	.082	.109
3	.050	.022	.025	.027	.027	.023	.017	.025	.073	.135
4	.100	.021	.014	.020	.026	.016	.022	.021	.092	.143
5	.150	.011	.014	.018	.016	.012	.012	.029	.041	.130
6	.200	.007	.019	.011	.011	.012	.015	.015	.045	.105
7	.250	.011	.014	.014	.013	.011	.007	.023	.074	.074
8	.300	.006	.008	.013	.012	.008	.012	.017	.044	******
9	.400	.003	.007	.012	.008	.007	.010	.012	.060	******
10	.500	.005	.007	.003	.004	.006	.009	.011	.048	.107
11	.650	******	.006	.005	.003	.008	.026	.013	.030	.070
12	.780	.003	.006	.005	.004	.008	.034	.021	.023	.066
13	.900	.003	.005	.005	.005	.010	.032	.048	.030	
14	.050	.029	.047	.057	.100	.103	.145	.215	.361	
15	.100	.018	.028	.032	.046	.048	.087	.265	.376	
16	.200	.009	.020	.031	.014	.016	.049	.132	.201	
17	.300	.012	.018	.010	.014	.011	.037	.092	.075	
18	.500	.006	.007	.003	.009	.006	.016	.057	******	
19	.650	.005	.006	.006	.005	.006	.049	.139	.110	
20	.780	.006	.005	.004	.006	.007	.055	.121	.135	
21	.900	.007	.005	.006	.006	.009	.084	.109	.094	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.174	.087	.047	******	.066	.084	.050	.076	.057	.032
2	.025	.162	.085	.074	.103	.112	.098	.086	.056	.061	.064
3	.050	.126	.088	.078	.098	.072	.088	.079	.049	.061	.030
4	.100	.058	.041	.022	.052	.019	.089	.036	.036	.035	.021
5	.150	.040	.028	.024	.026	.019	.050	.025	.041	.031	.023
6	.200	.038	.027	.017	.023	.021	******	.016	.017	.029	.016
7	.250	.044	.021	.012	.013	.015	.014	.015	.019	.006	.016
8	.300	.037	.019	.015	.010	.008	.008	.014	.017	.005	******
9	.400	.017	******	.009	.006	.009	.007	******	******	.006	******
10	.500	.021	******	.008	******	******	.005	******	.008	.007	.009
11	.650	******	.016	.007	.007	.004	.004	.003	.005	.005	.006
12	.780	.035	.009	.009	.005	.005	.005	.005	.006	.002	.006
13	.900	.031	.046	.042	.042	.038	.038	.027	.028	.030	.036
14	.050	.064	.011	.020	.021	.020	.027	.028	.031	.028	.026
15	.100	.058	.012	.018	.021	.018	.023	.015	.019	.028	.023
16	.200	.030	.008	.016	.010	.017	.011	.014	.015	.014	.013
17	.300	.021	.009	.011	.010	.012	.010	.011	.014	.012	.008
18	.500	.011	.008	.006	.003	.007	.006	.008	.009	.008	.004
19	.650	******	.007	.003	.004	.003	.003	.005	.004	.005	.004
20	.780	.016	.007	.002	.004	.003	.003	.003	.002	.004	.002
21	.900	.017	.006	.007	.006	.007	.008	.010	.004	.004	.003

THE MAX STANDARD DEVIATION IS .39 OCCURRING AT I = 1 AND J = 7.

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE A.4.- CONTINUED

RUN 65 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.025	.033	******	.054	******	.105	.065	.034	.010
2	.025	.027	.033	.037	.030	.021	.018	.008	.020	.012
3	.050	[illegible]	.032	.027	.023	.020	.016	.012	.017	.011
4	.100	.019	.021	.025	.022	.019	.018	.012	.013	.007
5	.150	.013	.012	.017	.014	.020	.013	.013	.014	.010
6	.200	.010	.015	.018	.015	.016	.011	.009	.009	.008
7	.250	.010	.014	.014	.017	.014	.011	.008	.011	.010
8	.300	.007	.012	.014	.014	.009	.009	.006	.008	******
9	.400	.007	.007	.010	.009	.006	.005	.016	.008	******
10	.500	.004	.007	.007	.008	.005	.005	.007	.009	.010
11	.650	******	.007	.007	.004	.003	.006	.013	.010	.013
12	.780	.003	.005	.006	.003	.003	.015	.012	.021	.011
13	.900	.024	.015	.007	.005	.004	.015	.040	.015	
14	.950	.034	.041	.033	.052	.126	.037	.092	.016	
15	.100	.018	.026	.033	.049	.036	.023	.024	.015	
16	.200	.011	.014	.023	.015	.023	.017	.023	.021	
17	.300	.011	.016	.005	.017	.014	.009	.027	.012	
18	.500	.005	.009	.013	.005	.007	.010	.021	******	
19	.650	.010	.010	.007	.005	.004	.007	.014	.013	
20	.780	.005	.005	.005	.003	.006	.011	.016	.015	
21	.900	.005	.004	.005	.003	.004	.018	.031	.022	

I	X	Y= .10	Y= .20	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.188	.264	.129	******	.059	.087	.075	.096	.075	.031
2	.025	.183	.297	.069	.083	.048	.081	.060	.052	.050	.049
3	.050	.172	.054	.070	.062	.061	.095	.093	.046	.045	.032
4	.100	.151	.073	.043	.046	.025	.023	.024	.067	.033	.023
5	.150	.185	.049	.025	.027	.030	.020	.028	.024	.034	.013
6	.200	.110	.034	.020	.023	.015	******	.024	.012	.016	.013
7	.250	.150	.043	.021	.017	.019	.012	.015	.015	.010	.014
8	.300	.124	.033	.022	.025	.016	.014	.011	.018	.010	******
9	.400	.126	******	.017	.015	.010	.008	******	******	.012	******
10	.500	.091	******	.024	******	******	.014	******	.006	.006	.007
11	.650	******	.029	.020	.018	.011	.010	.007	.005	.005	.007
12	.780	.045	.039	.023	.014	.012	.010	.009	.005	.002	.007
13	.900	.037	.022	.010	.008	.003	.005	.004	.005	.003	.005
14	.950	.102	.039	.019	.020	.018	.021	.023	.024	.026	.019
15	.100	.088	.030	.014	.018	.019	.022	.031	.025	.021	.017
16	.200	.070	.020	.013	.009	.015	.011	.016	.015	.012	.012
17	.300	.043	.017	.017	.006	.010	.012	.011	.011	.009	.010
18	.500	.073	.014	.074	.005	.006	.005	.005	.007	.007	.009
19	.650	******	.017	.004	.005	.004	.004	.003	.003	.004	.003
20	.780	.035	.015	.007	.004	.005	.005	.003	.003	.005	.004
21	.900	.036	.020	.008	.005	.007	.006	.006	.003	.005	.005

THE MAX STANDARD DEVIATION IS .26 OCCURRING AT I = 1 AND J = 11.

TABLE A.4.- CONTINUED

RUN 66 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.016	.014	******	.039	******	.064	.059	.042	.013
2	.025	.038	.043	.049	.048	.042	.037	.035	.054	.023
3	.050	.024	.032	.025	.040	.033	.046	.034	.033	.020
4	.100	.017	.019	.014	.02[illegible]	.028	.029	.024	.024	.016
5	.150	.011	.022	.013	.025	.035	.021	.023	.020	.017
6	.200	.012	.013	.020	.023	.024	.018	.019	.016	.016
7	.250	.006	.009	.012	.014	.013	.025	.018	.014	.016
8	.300	.008	.012	.015	.015	.018	.016	.015	.013	******
9	.400	.005	.005	.021	.014	.013	.012	.010	.009	******
10	.500	.002	.007	.009	.010	.010	.011	.009	.008	.007
11	.650	******	.005	.005	.008	.008	.008	.008	.005	.008
12	.780	.004	.004	.006	.005	.007	.005	.006	.006	.003
13	.900	.004	.004	.004	.003	.004	.005	.004	.003	
14	.050	.032	.035	.043	.038	.058	.058	.098	.043	
15	.100	.025	.029	.034	.041	.039	.051	.050	.056	
16	.200	.007	.013	.015	.022	.022	.026	.035	.027	
17	.300	.006	.013	.013	.023	.020	.021	.015	.016	
18	.500	.006	.008	.008	.011	.008	.012	.012	******	
19	.650	.005	.007	.012	.008	.011	.007	.006	.006	
20	.780	.005	.005	.005	.004	.009	.006	.003	.005	
21	.900	.008	.003	.003	.004	.005	.014	.006	.005	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.138	.088	.090	******	.018	.021	.016	.009	.019	.018
2	.025	.042	.049	.062	.048	.061	.049	.059	.058	.054	.028
3	.050	.045	.048	.045	.054	.033	.033	.037	.031	.022	.029
4	.100	.029	.029	.037	.029	.032	.025	.025	.022	.031	.017
5	.150	.023	.030	.034	.030	.024	.021	.018	.022	.015	.016
6	.200	.019	.025	.025	.023	.022	******	.016	.012	.012	.014
7	.250	.018	.020	.027	.019	.016	.016	.014	.010	.003	.008
8	.300	.016	.016	.016	.017	.012	.012	.011	.010	.003	******
9	.400	.011	******	.011	.011	.009	.009	******	******	.005	******
10	.500	.013	******	.011	******	******	.006	******	.004	.004	.005
11	.650	******	.010	.007	.005	.006	.004	.004	.005	.003	.003
12	.780	.004	.003	.005	.006	.006	.005	.004	.003	.002	.005
13	.900	.005	.003	.009	.016	.029	.032	.009	.004	.002	.003
14	.050	.071	.077	.066	.037	.045	.048	.037	.039	.025	.020
15	.100	.061	.051	.045	.033	.033	.040	.028	.023	.022	.020
16	.200	.039	.027	.034	.020	.028	.023	.021	.016	.012	.009
17	.300	.017	.020	.025	.016	.017	.017	.014	.008	.012	.007
18	.500	.011	.012	.012	.015	.014	.010	.012	.006	.003	.005
19	.650	******	.010	.010	.012	.008	.004	.008	.007	.003	.003
20	.780	.003	.006	.007	.006	.007	.007	.008	.003	.003	.002
21	.900	.006	.007	.003	.004	.005	.004	.004	.003	.002	.003

THE MAX STANDARD DEVIATION IS .14 OCCURRING AT I = 1 AND J = 10.

TABLE A.4.- CONTINUED

RUN 67 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.025	.021	******	.062	******	.063	.072	.047	.018
2	.025	.032	.032	.035	.028	.028	.037	.033	.030	.016
3	.050	.022	.033	.033	.033	.033	.030	.025	.021	.015
4	.100	.021	.022	.027	.019	.027	.027	.032	.012	.019
5	.150	.013	.024	.025	.022	.020	.022	.023	.015	.015
6	.200	.008	.012	.010	.018	.022	.018	.015	.013	.014
7	.250	.010	.012	.015	.022	.011	.017	.016	.011	.009
8	.300	.007	.012	.015	.021	.015	.013	.010	.009	******
9	.400	.005	.008	.011	.012	.013	.010	.006	.008	******
10	.500	.025	.007	.007	.007	.003	.007	.007	.006	.005
11	.650	******	.007	.005	.007	.009	.005	.005	.006	.005
12	.780	.003	.007	.005	.006	.005	.004	.003	.005	.006
13	.900	.003	.003	.003	.004	.006	.005	.003	.003	
14	.050	.025	.044	.044	.047	.063	.036	.050	.018	
15	.100	.025	.031	.032	.042	.051	.052	.044	.058	
16	.200	.014	.015	.027	.027	.022	.022	.017	.036	
17	.300	.007	.011	.017	.019	.017	.011	.023	.011	
18	.500	.015	.005	.010	.012	.015	.009	.005	******	
19	.650	.005	.005	.010	.008	.010	.007	.009	.005	
20	.780	.003	.004	.005	.007	.005	.006	.005	.004	
21	.900	.003	.003	.004	.005	.006	.006	.010	.007	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.143	.197	.437	******	.094	.029	.024	.017	.054	.035
2	.025	.032	.037	.054	.085	.075	.059	.061	.037	.045	.033
3	.050	.025	.054	.035	.056	.074	.038	.031	.033	.040	.021
4	.100	.030	.043	.054	.039	.031	.023	.030	.015	.021	.014
5	.150	.013	.032	.039	.052	.027	.023	.019	.015	.012	.031
6	.200	.013	.030	.040	.030	.020	******	.014	.013	.010	.012
7	.250	.012	.013	.032	.027	.017	.013	.012	.014	.009	.010
8	.300	.012	.021	.032	.025	.016	.017	.009	.005	.007	******
9	.400	.009	******	.019	.017	.014	.021	******	******	.004	******
10	.500	.007	******	.022	******	******	.023	******	.009	.004	.004
11	.650	******	.038	.017	.015	.021	.027	.019	.007	.003	.004
12	.780	.022	.035	.019	.012	.025	.019	.020	.004	.002	.004
13	.900	.028	.010	.003	.008	.017	.026	.011	.003	.002	.003
14	.050	.360	.153	.279	.169	.189	.047	.029	.011	.023	.021
15	.100	.245	.059	.062	.055	.066	.036	.020	.012	.018	.013
16	.200	.097	.028	.045	.042	.035	.021	.012	.007	.012	.008
17	.300	.018	.019	.022	.024	.016	.017	.011	.008	.006	.005
18	.500	.056	.009	.015	.015	.013	.008	.007	.005	.005	.004
19	.650	******	.137	.035	.009	.010	.009	.007	.004	.003	.003
20	.780	.064	.030	.034	.006	.011	.013	.009	.002	.005	.004
21	.900	.076	.007	.005	.007	.011	.012	.013	.005	.003	.003

THE MAX STANDARD DEVIATION IS .44 OCCURRING AT I = 1 AND J = 12.

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.4.- CONTINUED

RUN 63 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.015	.014	******	.058	******	.064	.068	.062	.008
2	.025	.041	.041	.042	.038	.037	.029	.025	.019	.010
3	.050	.016	.026	.023	.035	.033	.022	.018	.021	.014
4	.100	.019	.034	.019	.021	.030	.023	.029	.015	.010
5	.150	.011	.024	.022	.019	.023	.015	.013	.012	.011
6	.200	.011	.012	.014	.020	.017	.014	.007	.009	.005
7	.250	.011	.010	.017	.017	.012	.014	.010	.079	.008
8	.300	.006	.011	.014	.015	.014	.009	.007	.007	******
9	.400	.007	.008	.010	.011	.009	.010	.006	.006	******
10	.500	.005	.005	.011	.008	.009	.005	.003	.005	.004
11	.650	******	.006	.004	.005	.006	.006	.008	.005	.006
12	.780	.004	.005	.005	.003	.006	.005	.004	.005	.007
13	.900	.003	.004	.005	.007	.007	.005	.005	.006	
14	.050	.054	.048	.047	.052	.050	.051	.048	.016	
15	.100	.021	.025	.035	.034	.037	.041	.031	.271	
16	.200	.012	.016	.020	.019	.022	.018	.012	.070	
17	.300	.007	.017	.015	.018	.013	.011	.023	.040	
18	.500	.007	.006	.011	.012	.009	.011	.013	******	
19	.650	.005	.008	.007	.007	.006	.005	.012	.005	
20	.780	.005	.003	.005	.007	.006	.004	.015	.004	
21	.900	.003	.004	.004	.004	.005	.004	.011	.009	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.251	.639	.334	******	.234	.188	.239	.093	.072	.044
2	.025	.035	.020	.026	.067	.164	.205	.207	.060	.048	.040
3	.050	.031	.019	.034	.097	.159	.103	.123	.065	.041	.030
4	.100	.016	.026	.043	.079	.114	.070	.072	.037	.025	.025
5	.150	.018	.021	.045	.099	.108	.102	.026	.025	.014	.015
6	.200	.011	.017	.023	.070	.091	******	.017	.022	.011	.008
7	.250	.011	.014	.023	.057	.105	.069	.022	.017	.008	.014
8	.300	.012	.010	.025	.092	.086	.101	.041	.018	.011	******
9	.400	.008	******	.025	.057	.052	.092	******	******	.012	******
10	.500	.010	******	.018	******	******	.061	******	.013	.012	.007
11	.650	******	.010	.023	.039	.073	.067	.052	.016	.008	.005
12	.780	.021	.027	.024	.031	.057	.057	.085	.009	.005	.007
13	.900	.032	.047	.042	.037	.042	.056	.075	.013	.008	.007
14	.050	.273	.385	.547	.489	.194	.091	.053	.015	.012	.014
15	.100	.223	.125	.304	.234	.097	.070	.037	.022	.010	.013
16	.200	.202	.039	.122	.076	.063	.056	.019	.013	.011	.011
17	.300	.058	.059	.034	.085	.094	.067	.039	.005	.008	.006
18	.500	.046	.127	.071	.142	.145	.067	.035	.004	.006	.005
19	.650	******	.128	.139	.138	.135	.085	.055	.006	.005	.004
20	.780	.091	.096	.120	.119	.100	.082	.035	.006	.008	.004
21	.900	.106	.100	.102	.128	.111	.050	.037	.009	.005	.004

THE MAX STANDARD DEVIATION IS .64 OCCURRING AT I = 1 AND J = 11.

TABLE A.4.- CONTINUED

RUN 7[illegible]   STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	.010	.009	******	.023	******	.013	.035	.024	.014
2	.025	.029	.072	.011	.030	.106	.041	.043	.095	.005
3	.050	.023	.049	.033	.034	.053	.042	.043	.040	.023
4	.100	.021	.011	.024	.021	.021	.026	.044	.027	.018
5	.150	.010	.011	.015	.009	.020	.009	.015	.017	.011
6	.200	.007	.019	.017	.022	.006	.026	.016	.014	.013
7	.250	.008	.005	.005	.028	.018	.008	.009	.015	.006
8	.300	.005	.011	.005	.014	.014	.006	.006	.014	******
9	.400	.005	.007	.010	.003	.007	.017	.010	.006	******
10	.500	.011	.004	.009	.012	.012	.011	.011	.006	.004
11	.650	******	.005	.009	.002	.003	.003	.012	.004	.007
12	.780	.003	.003	.003	.002	.004	.005	.002	.004	.002
13	.900	.003	.002	.011	.005	.007	.004	.002	.003	
14	.050	.028	.038	.033	.042	.045	.015	.022	.027	
15	.100	.006	.016	.023	.014	.028	.031	.024	.017	
16	.200	.013	.010	.016	.013	.028	.020	.018	.024	
17	.300	.006	.003	.012	.020	.006	.006	.024	.018	
18	.500	.003	.002	.015	.005	.010	.005	.005	******	
19	.650	.002	.006	.009	.009	.012	.005	.005	.005	
20	.780	.003	.007	.004	.005	.007	.004	.001	.002	
21	.900	.005	.005	.004	.009	.009	.001	.009	.004	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.020	.018	.027	******	.014	.014	.005	.011	.004	.006
2	.025	.045	.063	.075	.076	.078	.105	.056	.021	.035	.048
3	.050	.039	.035	.038	.020	.029	.059	.045	.109	.055	.027
4	.100	.012	.039	.037	.045	.032	.043	.023	.022	.023	.020
5	.150	.028	.015	.024	.034	.031	.019	.026	.025	.016	.015
6	.200	.027	.020	.022	.025	.011	******	.014	.018	.007	.007
7	.250	.019	.013	.014	.007	.018	.007	.020	.018	.005	.010
8	.300	.010	.010	.003	.016	.014	.010	.013	.015	.009	******
9	.400	.019	******	.014	.011	.008	.008	******	******	.003	******
10	.500	.008	******	.013	******	******	.013	******	.015	.001	.002
11	.650	******	.005	.006	.007	.008	.005	.006	.003	.003	.002
12	.780	.003	.005	.005	.005	.005	.004	.002	.002	.003	.002
13	.900	.003	.002	.004	.008	.012	.004	.007	.004	.002	.003
14	.050	.002	.019	.044	.033	.047	.015	.025	.018	.030	.025
15	.100	.016	.012	.023	.025	.009	.041	.034	.026	.023	.019
16	.200	.026	.015	.025	.019	.017	.009	.017	.016	.003	.017
17	.300	.013	.012	.035	.002	.013	.018	.023	.015	.009	.003
18	.500	.008	.009	.014	.006	.004	.005	.009	.005	.005	.005
19	.650	******	.009	.010	.008	.005	.005	.007	.001	.003	.004
20	.780	.003	.005	.006	.008	.005	.008	.003	.004	.006	.003
21	.900	.006	.009	.010	.005	.004	.006	.004	.007	.005	.016

THE MAX STANDARD DEVIATION IS .11 OCCURRING AT I = 3 AND J = 17.

TABLE A.4.- CONTINUED

RUN 71 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.047	.034	******	.035	******	.091	.048	.093	.014
2	.025	.027	.043	.076	.092	.065	.042	.064	.073	.011
3	.050	.023	.044	.023	.043	.042	.035	.075	.042	.015
4	.100	.019	.034	.024	.045	.011	.034	.008	.017	.004
5	.150	.011	.016	.046	.004	.025	.028	.011	.024	.026
6	.200	.017	.013	.009	.006	.011	.006	.010	.012	.011
7	.250	.015	.018	.005	.010	.007	.021	.011	.018	.007
8	.300	.005	.011	.010	.012	.015	.014	.012	.010	******
9	.400	.010	.005	.013	.004	.011	.007	.011	.003	******
10	.500	.007	.007	.010	.007	.004	.004	.008	.005	.007
11	.650	******	.003	.003	.005	.003	.001	.005	.007	.004
12	.780	.005	.002	.002	.005	.003	.004	.002	.003	.003
13	.900	.004	.002	.002	.005	.003	.005	.003	.003	
14	.050	.009	.017	.029	.029	.025	.018	.037	.022	
15	.100	.004	.020	.014	.019	.029	.022	.022	.018	
16	.200	.015	.014	.017	.013	.014	.004	.020	.027	
17	.300	.002	.007	.006	.012	.010	.009	.013	.015	
18	.500	.007	.004	.007	.004	.002	.006	.012	******	
19	.650	.003	.004	.005	.007	.002	.004	.005	.001	
20	.780	.002	.004	.004	.004	.004	.002	.002	.003	
21	.900	.003	.005	.007	.005	.003	.010	.004	.003	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.066	.066	.080	******	.032	.031	.074	.028	.055	.016
2	.025	.072	.057	.054	.097	.048	.036	.040	.022	.047	.031
3	.050	.061	.028	.049	.033	.050	.040	.033	.070	.022	.005
4	.100	.028	.053	.052	.059	.028	.044	.050	.033	.031	.009
5	.150	.037	.011	.011	.015	.011	.029	.026	.027	.022	.004
6	.200	.021	.016	.007	.009	.011	******	.010	.014	.023	.012
7	.250	.021	.003	.009	.014	.012	.009	.007	.006	.010	.013
8	.300	.011	.013	.012	.016	.005	.029	.025	.004	.004	******
9	.400	.007	******	.007	.009	.004	.008	******	******	.003	******
10	.500	.005	******	.005	******	******	.003	******	.002	.005	.015
11	.650	******	.003	.002	.004	.003	.005	.006	.003	.002	.005
12	.780	.001	.004	.003	.003	.003	.003	.003	.002	.001	.003
13	.900	.003	.005	.002	.005	.003	.003	.003	.004	.001	.004
14	.050	.052	.024	.027	.011	.018	.019	.007	.016	.020	.013
15	.100	.027	.023	.013	.031	.017	.022	.023	.037	.037	.004
16	.200	.015	.015	.025	.010	.013	.017	.014	.011	.009	.009
17	.300	.010	.010	.015	.009	.018	.007	.013	.005	.005	.009
18	.500	.008	.004	.007	.004	.007	.004	.008	.008	.003	.003
19	.650	******	.003	.003	.004	.005	.005	.008	.006	.003	.003
20	.780	.005	.003	.003	.003	.007	.005	.005	.003	.005	.002
21	.900	.001	.003	.003	.004	.004	.006	.004	.004	.005	.003

THE MAX STANDARD DEVIATION IS .10 OCCURRING AT I = 2 AND J = 13.

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.4.- CONTINUED

RUN 72 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.046	.076	******	.082	******	.062	.120	.263	.015
2	.025	.030	.023	.047	.068	.084	.080	.124	.078	.043
3	.050	.012	.034	.007	.072	.036	.008	.031	.041	.035
4	.100	.015	.034	.023	.030	.059	.037	.028	.024	.017
5	.150	.022	.014	.023	.008	.018	.021	.011	.016	.017
6	.200	.008	.011	.012	.011	.015	.015	.016	.011	.010
7	.250	.014	.007	.004	.009	.016	.009	.009	.004	.007
8	.300	.007	.047	.008	.015	.002	.005	.005	.006	******
9	.400	.004	.006	.005	.007	.009	.006	.004	.074	******
10	.500	.004	.001	.001	.002	.002	.004	.003	.006	.007
11	.650	******	.003	.012	.014	.002	.003	.005	.005	.003
12	.780	.004	.002	.002	.004	.004	.004	.003	.001	.004
13	.900	.004	.004	.001	.004	.003	.001	.005	.007	
14	.050	.015	.013	.027	.014	.022	.018	.011	.020	
15	.100	.005	.017	.015	.013	.024	.008	.015	.005	
16	.200	.005	.007	.008	.009	.016	.020	.017	.022	
17	.300	.003	.006	.017	.009	.008	.003	.013	.011	
18	.500	.003	.004	.009	.004	.006	.006	.008	******	
19	.650	.002	.003	.002	.007	.001	.003	.001	.003	
20	.780	.001	.002	.003	.002	.008	.002	.002	.002	
21	.900	.001	.003	.003	.003	.005	.001	.002	.003	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.144	.163	.184	******	.102	.046	.064	.039	.056	.042
2	.025	.049	.060	.034	.084	.038	.101	.025	.053	.083	.023
3	.050	.037	.031	.026	.059	.054	.043	.064	.059	.071	.037
4	.100	.021	.022	.017	.046	.017	.015	.039	.016	.025	.033
5	.150	.023	.039	.023	.014	.017	.014	.014	.010	.017	.005
6	.200	.009	.014	.017	.029	.012	******	.015	.008	.002	.003
7	.250	.007	.012	.011	.014	.012	.011	.015	.010	.008	.011
8	.300	.005	.018	.013	.009	.012	.009	.011	.005	.002	******
9	.400	.002	******	.009	.004	.005	.007	******	******	.005	******
10	.500	.002	******	.004	******	******	.004	******	.003	.003	.003
11	.650	******	.003	.005	.002	.004	.001	.003	.004	.002	.003
12	.780	.003	.003	.007	.003	.004	.003	.003	.002	.002	.004
13	.900	.001	.004	.002	.003	.002	.002	.003	.002	.004	.002
14	.050	.016	.010	.037	.022	.023	.029	.021	.011	.016	.021
15	.100	.007	.025	.014	.010	.027	.026	.020	.019	.019	.013
16	.200	.014	.021	.020	.012	.008	.011	.014	.005	.017	.005
17	.300	.006	.007	.009	.005	.007	.012	.006	.005	.010	.004
18	.500	.010	.009	.004	.002	.003	.005	.005	.007	.001	.003
19	.550	******	.001	.012	.003	.009	.008	.003	.005	.003	.004
20	.780	.003	.002	.004	.002	.001	.003	.002	.003	.003	.003
21	.900	.006	.003	.003	.003	.003	.001	.003	.002	.002	.001

THE MAX STANDARD DEVIATION IS .26 OCCURRING AT I = 1 AND J = 8.

TABLE A.4.- CONTINUED

RUN 73 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.50	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.044	.124	******	.049	******	.066	.043	.102	.025
2	.025	.032	.126	.073	.057	.123	.095	.031	.011	.039
3	.050	.054	.020	.008	.040	.070	.039	.046	.040	.030
4	.100	.037	.018	.021	.021	.037	.017	.015	.019	.032
5	.150	.018	.009	.011	.019	.018	.024	.010	.008	.008
6	.200	.007	.005	.016	.019	.010	.016	.010	.013	.004
7	.250	.020	.009	.014	.018	.007	.006	.009	.009	.005
8	.300	.008	.003	.003	.005	.005	.007	.008	.004	******
9	.400	.004	.005	.002	.005	.004	.005	.004	.018	******
10	.500	.004	.003	.002	.004	.003	.002	.003	.005	.003
11	.650	******	.002	.005	.006	.005	.006	.009	.010	.002
12	.780	.003	.002	.002	.002	.004	.003	.002	.005	.007
13	.900	.002	.002	.003	.002	.002	.002	.008	.023	
14	.050	.014	.019	.019	.018	.025	.014	.012	.009	
15	.100	.011	.017	.030	.011	.020	.010	.017	.017	
16	.200	.007	.009	.021	.009	.009	.008	.012	.010	
17	.300	.009	.014	.011	.012	.015	.008	.006	.007	
18	.500	.003	.002	.003	.004	.005	.004	.004	******	
19	.650	.001	.002	.003	.003	.004	.004	.003	.002	
20	.780	.003	.003	.002	.001	.003	.001	.003	.004	
21	.900	.002	.002	.004	.003	.003	.003	.003	.007	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.095	.039	.063	******	.174	.083	.107	.065	.051	.017
2	.025	.049	.085	.135	.049	.067	.074	.083	.068	.035	.016
3	.050	.034	.037	.033	.035	.044	.031	.054	.055	.055	.015
4	.100	.033	.054	.017	.030	.016	.034	.016	.038	.025	.003
5	.150	.018	.013	.011	.021	.021	.025	.023	.023	.032	.005
6	.200	.014	.010	.014	.014	.016	******	.006	.011	.004	.006
7	.250	.011	.007	.010	.013	.008	.010	.005	.016	.007	.005
8	.300	.007	.014	.005	.006	.009	.007	.009	.007	.005	******
9	.400	.005	******	.005	.005	.005	.006	******	******	.003	******
10	.500	.006	******	.004	******	******	.005	******	.001	.004	.002
11	.650	******	.004	.003	.002	.003	.003	.003	.003	.003	.004
12	.780	.002	.002	.005	.002	.002	.002	.004	.005	.002	.003
13	.900	.015	.013	.003	.003	.002	.003	.003	.003	.001	.002
14	.050	.019	.021	.024	.011	.019	.017	.013	.009	.015	.018
15	.100	.021	.014	.024	.014	.015	.014	.020	.013	.009	.007
16	.200	.004	.013	.021	.029	.015	.017	.008	.012	.005	.007
17	.300	.010	.011	.006	.007	.006	.006	.011	.009	.008	.005
18	.500	.004	.002	.007	.003	.004	.005	.008	.009	.005	.004
19	.650	******	.004	.003	.004	.002	.001	.008	.002	.003	.001
20	.780	.003	.003	.002	.006	.002	.001	.003	.004	.002	.001
21	.900	.006	.002	.003	.001	.002	.005	.002	.002	.001	.002

THE MAX STANDARD DEVIATION IS .17 OCCURRING AT I = 1 AND J = 14.

TABLE A.4.- CONCLUDED

RUN 74 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.045	.037	******	.262	******	.109	.073	.151	.033
2	.025	.054	.043	.132	.117	.047	1.840	.013	.034	.012
3	.050	.049	.024	.015	.014	.080	.030	.018	.005	.025
4	.100	.028	.023	.037	.025	.018	.026	.013	.017	.015
5	.150	.010	.014	.016	.014	.022	.010	.006	.021	.011
6	.200	.012	.005	.012	.011	.005	.013	.010	.006	.004
7	.250	.005	.014	.003	.004	.006	.007	.010	.012	.008
8	.300	.008	.003	.003	.007	.005	.007	.010	.026	******
9	.400	.006	.005	.004	.003	.012	.003	.019	.025	******
10	.500	.004	.004	.003	.006	.003	.006	.020	.039	.009
11	.650	******	.003	.003	.007	.005	.009	.009	.008	.004
12	.780	.006	.001	.005	.006	.006	.004	.019	.032	.007
13	.900	.006	.002	.004	.005	.002	.007	.017	.023	
14	.050	.014	.014	.021	.017	.008	.008	.015	.010	
15	.100	.010	.004	.018	.015	.010	.017	.015	.011	
16	.200	.006	.006	.010	.016	.014	.005	.019	.015	
17	.300	.005	.008	.012	.009	.004	.007	.003	.013	
18	.500	.002	.003	.001	.004	.003	.005	.004	******	
19	.650	.003	.002	.005	.003	.011	.003	.003	.001	
20	.780	.003	.001	.002	.004	.002	.007	.005	.002	
21	.900	.002	.002	.004	.003	.001	.008	.005	.011	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.057	.214	.335	******	.153	.100	.199	.072	.124	.114
2	.025	.015	.033	.052	.054	.094	.132	.090	.141	.073	.025
3	.050	.032	.030	.016	.011	.016	.011	.023	.066	.009	.043
4	.100	.018	.019	.013	.017	.029	.013	.020	.036	.025	.012
5	.150	.018	.015	.023	.008	.009	.015	.026	.015	.018	.006
6	.200	.021	.005	.014	.013	.018	******	.007	.011	.007	.006
7	.250	.011	.010	.005	.006	.015	.008	.003	.005	.006	.007
8	.300	.014	.004	.004	.006	.008	.009	.003	.008	.010	******
9	.400	.007	******	.004	.003	.005	.004	******	******	.005	******
10	.500	.018	******	.006	******	******	.005	******	.003	.005	.006
11	.650	******	.003	.003	.002	.003	.003	.004	.004	.003	.002
12	.780	.015	.002	.003	.003	.002	.002	.002	.004	.002	.004
13	.900	.015	.007	.003	.002	.001	.004	.003	.004	.003	.002
14	.050	.007	.019	.013	.013	.007	.004	.017	.005	.013	.013
15	.100	.012	.007	.023	.022	.012	.013	.010	.023	.011	.013
16	.200	.019	.003	.009	.016	.024	.024	.014	.013	.019	.010
17	.300	.014	.008	.006	.011	.007	.006	.009	.008	.009	.006
18	.500	.003	.003	.005	.003	.007	.005	.006	.005	.003	.008
19	.650	******	.003	.005	.005	.003	.003	.004	.007	.001	.003
20	.780	.006	.002	.003	.002	.002	.003	.002	.002	.002	.002
21	.900	.006	.005	.004	.003	.002	.004	.003	.004	.002	.003

THE MAX STANDARD DEVIATION IS 1.84 OCCURRING AT I = 2 AND J = 6.

ORIGINAL PAGE IS OF POOR QUALITY

TABLE A.5.- TARE RUN (RUN 69) - PRESSURE MODEL

(a) Integrated results.

RUN 69 SECTION COEFFICIENTS

J	Y	LIFT	ALPHASUBS	LIFT FROM ALPHASUBS	CL LONG EDGE
1	-.950	.024	.171	.018	.002
2	-.850	.027	.114	.012	.003
3	-.700	.011	.129	.014	.003
4	-.550	.006	.088	.009	.002
5	-.400	.015	.162	.017	.004
6	-.250	.025	.185	.020	.004
7	-.100	.030	.298	.032	.007
8	-.050	.040	.486	.052	.012
9	0.000	.036	*******	******	******
10	.100	.037	.476	.051	.012
11	.250	.044	.443	.047	.011
12	.400	.040	.467	.050	.011
13	.450	.034	.458	.049	.011
14	.500	.032	.455	.050	.011
15	.550	.037	.497	.053	.012
16	.650	.037	.474	.051	.012
17	.750	.034	.410	.044	.010
18	.850	.024	.388	.042	.009
19	.950	.019	.469	.050	.011

LOAD COEFFICIENTS

	LIFT	ROLLING MOMENT
LEFT WING	.009	.0017
RIGHT WING	.017	-.0038
TOTAL	.026	-.0020
FROM ALPHASUBS	.033	-.0040

QAVE = 30.087 PSF (STANDARD DEVIATION = .007 PSF)

TEMP = 26. DEG. CENT. BARO. PRESSURE = 29.91 IN. HG.

TABLE A.5.- CONTINUED.

(b) Surface pressure coefficients.

RUN 67 AVERAGED PRESSURE COEFFICIENTS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.05	Y= 0.
1	0.000	1.002	1.001	******	1.003	******	1.004	.998	.933	.412
2	.025	-.243	-.273	-.223	-.321	-.297	-.310	-.391	-.500	-.527
3	.050	-.326	-.343	-.331	-.359	-.351	-.344	-.402	-.498	-.555
4	.100	-.335	-.379	-.395	-.403	-.410	-.365	-.415	-.472	-.510
5	.150	-.329	-.369	-.373	-.376	-.399	-.363	-.395	-.438	-.448
6	.200	-.295	-.340	-.335	-.352	-.353	-.353	-.361	-.390	-.408
7	.250	-.269	-.327	-.334	-.332	-.330	-.337	-.348	-.339	-.372
8	.300	-.241	-.277	-.292	-.299	-.296	-.303	-.315	-.321	******
9	.400	-.179	-.211	-.231	-.234	-.234	-.232	-.235	-.241	******
10	.500	-.174	-.224	-.217	-.207	-.202	-.205	-.199	-.204	-.137
11	.550	******	-.134	-.137	-.133	-.128	-.121	-.115	-.093	-.090
12	.750	-.064	-.065	-.078	-.072	-.061	-.053	-.023	.013	.037
13	.900	.071	.067	.065	.108	.094	.082	.112	.103	
14	.050	-.299	-.305	-.332	-.321	-.300	-.274	-.289	-.313	
15	.100	-.334	-.372	-.391	-.372	-.362	-.359	-.387	-.347	
16	.200	-.279	-.327	-.342	-.350	-.339	-.320	-.337	-.391	
17	.300	-.275	-.319	-.321	-.312	-.305	-.328	-.312	-.315	
18	.500	-.149	-.162	-.165	-.175	-.168	-.156	-.161	******	
19	.650	-.091	-.104	-.113	-.104	-.099	-.086	-.074	-.041	
20	.750	-.018	-.015	-.043	-.073	-.071	-.032	-.001	.007	
21	.900	.083	.091	.057	.054	.063	.080	.131	.127	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	1.063	.999	1.000	******	1.071	1.003	1.002	1.001	1.001	1.000
2	.025	-.447	-.393	-.392	-.375	-.363	-.365	-.342	-.373	-.347	-.257
3	.050	-.472	-.440	-.445	-.450	-.448	-.454	-.435	-.439	-.368	-.370
4	.100	-.420	-.390	-.403	-.412	-.420	-.418	-.418	-.399	-.400	-.373
5	.150	-.437	-.384	-.378	-.338	-.362	-.366	-.388	-.378	-.371	-.331
6	.200	-.373	-.355	-.320	-.362	-.362	******	-.359	-.342	-.332	-.239
7	.250	-.359	-.334	-.334	-.331	-.332	-.334	-.334	-.326	-.301	-.254
8	.300	-.331	-.327	-.314	-.324	-.315	-.315	-.311	-.323	-.317	******
9	.400	-.241	******	-.235	-.245	-.248	-.240	******	******	-.237	******
10	.500	-.200	******	-.202	******	******	-.213	******	-.209	-.198	-.130
11	.550	******	-.121	-.126	-.120	-.132	-.140	-.139	-.137	-.137	-.111
12	.750	-.093	-.023	-.045	-.045	-.055	-.067	-.052	-.061	-.059	-.033
13	.900	.133	.132	.093	.092	.038	.092	.085	.081	.094	.079
14	.050	-.291	-.232	-.267	-.275	-.270	-.264	-.255	-.253	-.221	-.192
15	.100	-.355	-.310	-.305	-.333	-.353	-.333	-.353	-.376	-.377	-.337
16	.200	-.333	-.313	-.323	-.328	-.344	-.344	-.331	-.314	-.316	-.276
17	.300	-.297	-.281	-.289	-.292	-.299	-.298	-.297	-.305	-.301	-.262
18	.500	-.161	-.163	-.163	-.174	-.175	-.180	-.182	-.185	-.182	-.131
19	.650	******	-.089	-.094	-.097	-.099	-.103	-.105	-.109	-.110	-.099
20	.750	-.007	-.031	-.052	-.053	-.055	-.047	-.039	-.036	-.043	-.034
21	.900	.125	.120	.114	.072	.074	.069	.076	.092	.091	.079

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TABLE A.5.- CONCLUDED.

(c) Standard deviations for pressure coefficients.

RUN 59 STANDARD DEVIATIONS

I	X	Y=-.95	Y=-.85	Y=-.70	Y=-.55	Y=-.40	Y=-.25	Y=-.10	Y=-.06	Y= 0.
1	0.000	.004	.007	******	.004	******	.005	.007	.007	.007
2	.025	.028	.042	.055	.051	.043	.061	.055	.051	.017
3	.050	.029	.027	.035	.036	.046	.049	.041	.029	.010
4	.100	.017	.015	.022	.024	.022	.031	.024	.032	.021
5	.150	.016	.019	.022	.018	.029	.023	.018	.016	.013
6	.200	.009	.013	.015	.019	.015	.019	.014	.017	.010
7	.250	.007	.014	.010	.011	.011	.015	.009	.017	.012
8	.300	.006	.029	.017	.017	.014	.013	.012	.011	******
9	.400	.004	.007	.011	.009	.010	.009	.011	.011	******
10	.500	.001	.005	.005	.006	.007	.007	.007	.005	.007
11	.550	******	.004	.007	.007	.005	.007	.008	.005	.006
12	.760	.005	.004	.013	.004	.006	.006	.005	.004	.004
13	.900	.008	.005	.005	.003	.005	.008	.004	.003	
14	.050	.023	.027	.039	.032	.032	.036	.043	.029	
15	.100	.022	.021	.030	.036	.037	.031	.037	.030	
16	.200	.009	.019	.015	.013	.023	.019	.012	.025	
17	.300	.008	.010	.011	.016	.014	.015	.011	.013	
18	.500	.005	.005	.009	.009	.010	.007	.010	******	
19	.650	.005	.005	.005	.007	.004	.009	[illegible]	.004	
20	.760	.002	.003	.005	.005	.003	.006	.005	.003	
21	.900	.001	.002	.004	.012	.005	.003	.008	.005	

I	X	Y= .10	Y= .25	Y= .40	Y= .45	Y= .50	Y= .55	Y= .60	Y= .75	Y= .85	Y= .95
1	0.000	.006	.036	.039	******	.006	.006	.008	.009	.036	.008
2	.025	.064	.093	.053	.045	.064	.064	.060	.050	.041	.037
3	.050	.040	.036	.037	.048	.056	.036	.032	.043	.022	.037
4	.100	.025	.043	.034	.028	.030	.029	.031	.021	.025	.015
5	.150	.022	.023	.021	.022	.024	.024	.018	.019	.023	.016
6	.200	.022	.012	.019	.022	.021	******	.015	.016	.021	.011
7	.250	.012	.021	.017	.015	.018	.017	.017	.017	.011	.006
8	.300	.014	.014	.013	.013	.013	.012	.016	.008	.011	******
9	.400	.013	******	.010	.012	.011	.012	******	******	.010	******
10	.500	.007	******	.005	******	******	.005	******	.006	.005	.005
11	.650	******	.009	.006	.008	.007	.007	.005	.006	.005	.003
12	.760	.015	.008	.007	.007	.015	.005	.008	.006	.002	.003
13	.900	.005	.005	.008	.005	.007	.006	.005	.005	.005	.003
14	.050	.049	.039	.024	.030	.038	.033	.045	[illegible]	.025	.030
15	.100	.030	.020	.033	.025	.027	.025	.028	[illegible]	.017	.017
16	.200	.016	.023	.020	.026	.019	.018	.015	[illegible]	.015	.007
17	.300	.012	.015	.014	.017	.011	.013	.013	.011	.013	.007
18	.500	.012	.012	.010	.010	.008	.008	.009	.007	.008	.006
19	.650	******	.008	.008	.009	.008	.006	.005	.009	.006	.006
20	.760	.002	.008	.005	.005	.004	.003	.005	.005	.005	.007
21	.900	.004	.007	.009	.006	.004	.011	.006	.004	.005	.003

THE MAX STANDARD DEVIATION IS .06 OCCURRING AT I = 2 AND J = 10.

APPENDIX B

SLENDER-BODY ESTIMATE OF THE CONTRIBUTIONS TO SURFACE PRESSURE OF VORTEX BENDING AND NONLINEAR VELOCITY TERMS

Consider a general planar wing at zero angle of attack under the influence of a potential vortex at y_v, z_v in a free stream of velocity V_∞. In general, the velocity potential on the wing will have the functional form

$$\phi_w = \phi_w(x, y, s, y_v, z_v) \tag{B.1}$$

The velocity components are

$$u = \frac{\partial\phi_w}{\partial x} + \frac{\partial\phi_w}{\partial s}\frac{ds}{dx} + \frac{\partial\phi_w}{\partial y_v}\frac{dy_v}{dx} + \frac{\partial\phi_w}{\partial z_v}\frac{dz_v}{dx} \tag{B.2}$$

$$v = \frac{\partial\phi_w}{\partial y} \tag{B.3}$$

$$w = \frac{\partial\phi_w}{\phi z} \tag{B.4}$$

The condition $w = 0$ represents the boundary condition for the planar lifting surface. The derivatives dy_v/dx and dz_v/dx in equation (B.2) can be written

$$\left.\begin{aligned} \frac{dy_v}{dx} &= \frac{dy_v}{dt}\frac{dt}{dx} = \frac{v_v}{V_\infty} \\ \frac{dz_v}{dx} &= \frac{dz_v}{dt}\frac{dt}{dx} = \frac{w_v}{V_\infty} \end{aligned}\right\} \tag{B.5}$$

where v_v and w_v are the components of the velocity of the vortex in the crossflow plane. For a rectangular wing, equation (B.2) becomes

$$u = \frac{\partial \phi_w}{\partial x} + u_v \tag{B.6}$$

where

$$u_v = \frac{\partial \phi_w}{\partial y_v} \frac{v_v}{V_\infty} + \frac{\partial \phi_w}{\partial z_v} \frac{w_v}{V_\infty} \tag{B.7}$$

The pressure coefficient can be calculated from these velocity components using either the linearized relation

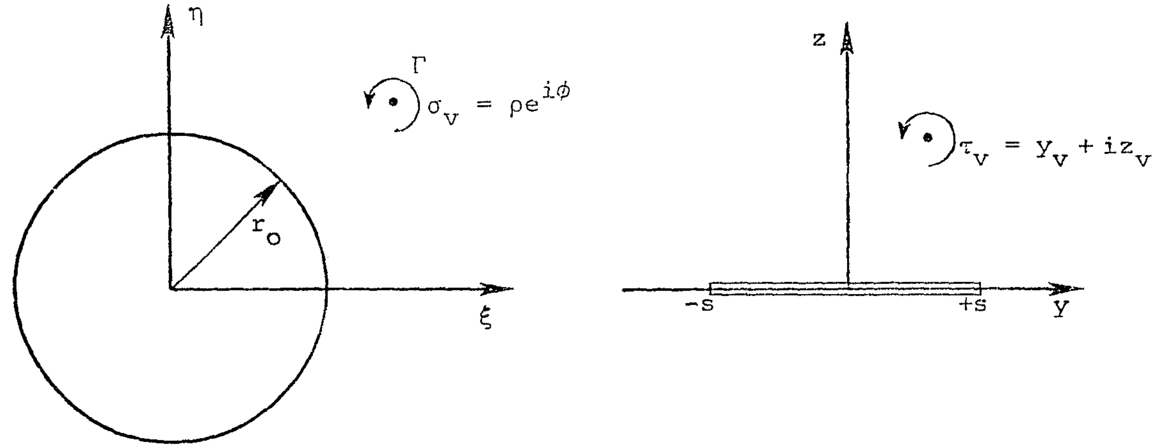
$$c_p = - \frac{2u}{V_\infty} \tag{B.8}$$

or the Bernoulli relation

$$c_p = - \frac{2u}{V_\infty} - \frac{(v^2 + w^2)}{V_\infty^2} \tag{B.9}$$

In the following, the contribution to either pressure coefficient of u_v (vortex bending) and the contribution of the nonlinear terms in equation (B.9) are evaluated, using a slender-body solution for ϕ_w. It is shown that these contributions are of the same order. Thus, if either contribution is included in an analysis, both should be. Note that this conclusion cannot be assumed to hold if the presence of the wing appreciably modifies the vortex structure from that used here; that is, if the point vortex becomes a cloud of distributed vorticity.

The potential ϕ_w is solved for by application of the methods of conformal transformation. In the crossflow plane, we have the lifting surface lying along the y-axis on the interval $-s \leq y \leq s$ with a vortex of strength Γ at (y_v, z_v). We will transform the lifting surface from a line into a circle with the flow undistorted at infinity.



$$\sigma = \xi + i\eta = re^{i\theta} \qquad \tau = y + iz \tag{B.10}$$

The equations of the transformations are (ref. 19)

$$\left.\begin{aligned} s &= 2r_o \\ \tau &= \sigma + \frac{r_o^2}{\sigma} \\ \frac{\sigma}{r_o} &= \frac{\tau}{s} + \sqrt{\frac{\tau^2}{s^2} - 1} \end{aligned}\right\} \tag{B.11}$$

The vortex at $\rho e^{i\phi}$ in the σ plane is related to that in the τ plane as follows:

$$y_v + iz_v = \rho e^{i\phi} + \frac{r_o^2}{\rho} e^{-i\phi} \tag{B.12}$$

$$\left.\begin{aligned} y_v &= \left(\rho + \frac{r_o^2}{\rho}\right) \cos \phi \\ z_v &= \left(\rho - \frac{r_o^2}{\rho}\right) \sin \phi \end{aligned}\right\} \qquad \text{(B.13)}$$

A point on the lifting surface is related to one on the circle through the relationship

$$y = 2r_o \cos \theta \qquad \text{(B.14)}$$

It is simple to write down the complex potential in the σ plane. The vortex at σ_v in the σ plane has an image vortex at $r_o^2/\bar{\sigma}_v$ of opposite sign with a vortex at the center of the circle to preserve the circulation at infinity. The entire complex potential is thus

$$W(\sigma) = -\frac{i\Gamma}{2\pi}\left[\ln(\sigma - \sigma_v) - \ln\left(\sigma - \frac{r_o^2}{\bar{\sigma}_v}\right) + \ln \sigma\right] \qquad \text{(B.15)}$$

and

$$\Phi(\sigma) = \frac{\Gamma}{2\pi}\left[\arg(\sigma - \sigma_v) - \arg\left(\sigma - \frac{r_o^2}{\bar{\sigma}_v}\right) + \arg \sigma\right] \qquad \text{(B.16)}$$

On the wing

$$\sigma = r_o e^{i\theta}$$

so that

$$\arg(\sigma - \sigma_v) = \arg\left(r_o e^{i\theta} - \rho e^{i\phi}\right)$$

$$= \tan^{-1}\left(\frac{r_o \sin\theta - \rho\sin\phi}{r_o\cos\theta - \rho\cos\phi}\right) \tag{B.17}$$

$$\arg\left(\sigma - \frac{r_o^2}{\bar{\sigma}_v}\right) = \arg\left(r_o e^{i\theta} - \frac{r_o^2}{\rho}e^{i\phi}\right)$$

$$= \arg r_o + \arg\left(\rho e^{i\theta} - r_o e^{i\phi}\right)$$

$$= \tan^{-1}\left(\frac{\rho\sin\theta - r_o\sin\phi}{\rho\cos\theta - r_o\cos\phi}\right) \tag{B.18}$$

On the wing the potential is thus

$$\Phi_w = \frac{\Gamma}{2\pi}\left[\tan^{-1}\left(\frac{r_o\sin\theta - \rho\sin\phi}{r_o\cos\theta - \rho\cos\phi}\right)\right.$$

$$\left. - \tan^{-1}\left(\frac{\rho\sin\theta - r_o\sin\phi}{\rho\cos\theta - r_o\cos\phi}\right) + \theta\right] \tag{B.19}$$

After a considerable amount of algebra, the derivatives $\partial\phi_w/\partial y_v$ and $\partial\phi_w/\partial z_v$ appearing in equation (B.7) are

$$\left.\begin{aligned} \frac{\partial\Phi_w}{\partial y_v} &= \left(\frac{\Gamma}{2\pi}\right)\frac{\rho(\rho^2 - r_o^2)\left[2r_o\rho\sin(\theta - \phi)\cos\phi - (\rho^2 + r_o^2)\sin\phi\right]}{\left[r_o^2 + \rho^2 - 2r_o\rho\cos(\theta - \phi)\right]\left(r_o^4 + \rho^4 - 2r_o^2\rho^2\cos 2\phi\right)} \\ \frac{\partial\phi_w}{\partial z_v} &= \left(\frac{\Gamma}{2\pi}\right)\frac{\rho\left[2r_o\rho(\rho^2 + r_o^2)\sin(\theta - \phi)\sin\phi + (\rho^2 - r_o^2)^2\cos\phi\right]}{\left[r_o^2 + \rho^2 - 2r_o\rho\cos(\theta - \phi)\right]\left(r_o^4 + \rho^4 - 2r_o^2\rho^2\cos 2\phi\right)} \end{aligned}\right\} \tag{B.20}$$

If the conjugate of the complex velocity of the vortex in the σ plane is denoted $V_V - iW_V$, then

$$V_V - iW_V = \lim_{\sigma \to \sigma_V} \frac{d}{d\sigma}\left[W(\sigma) + \frac{i\Gamma}{2\pi} \ln(\sigma - \sigma_V)\right] \tag{B.21}$$

The vortex velocity in the τ plane is not related to that in the σ plane by the usual conformal transformation, but is given by the following expression from reference 19.

$$v_V - iw_V = (V_V - iW_V) \left.\frac{d\sigma}{d\tau}\right|_{\tau=\tau_V} - \frac{i\Gamma}{4\pi} \left.\frac{d^2\sigma/d\tau^2}{d\sigma/d\tau}\right|_{\tau=\tau_V}$$

or

$$v_V - iw_V = \left\{\frac{i\Gamma}{2\pi} \frac{d\sigma}{d\tau} \frac{d}{d\sigma}\left[\ln\left(\sigma - \frac{r_o^2}{\bar{\sigma}_V}\right) - \ln \sigma\right] - \frac{i\Gamma}{4\pi}\left(\frac{d\tau}{d\sigma}\right)\left(\frac{d^2\sigma}{d\tau^2}\right)\right\}_{\substack{\tau \to \tau_V \\ \sigma \to \sigma_V}} \tag{B.22}$$

It can be shown that

$$v_V = \frac{\Gamma}{2\pi}\left[\frac{\rho}{(\rho^2 - r_o^2)(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi)^2}\right]\left\{\left[(\rho^2 + r_o^2)(\rho^6 + r_o^6) + r_o^2\rho^2(\rho^4 + r_o^4)\right] \sin \phi - 2r_o^4\rho^4 \sin 3\phi\right\} - \frac{\Gamma\rho}{2\pi} \frac{(\rho^2 + r_o^2)\sin\phi}{(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi)} \tag{B.23}$$

and

$$w_v = \frac{-\Gamma}{2\pi}\rho\cos\phi\,\frac{(\rho^2 + r_o^2)(\rho^4 + r_o^4)}{\left(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi\right)^2}$$

$$+ \frac{\Gamma\rho}{2\pi}\,\frac{(\rho^2 - r_o^2)\cos\phi}{\left(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi\right)} \qquad \text{(B.24)}$$

Substituting equations (B.20), (B.23) and (B.24) into the definition of u_v, equation (B.7), we find

$$\frac{u_v}{V_\infty} = \left(\frac{\Gamma}{2\pi V_\infty}\right)^2 \frac{\rho^2\left[4r_o^3\rho^3\sin(\epsilon - \phi)\sin\phi\cos\phi - (\rho^2 + r_o^2)(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos^2\phi)\right]}{\left[\rho^2 + r_o^2 - 2r_o\rho\cos(\theta - \phi)\right]\left(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi\right)^2}$$

$$+ \left(\frac{\Gamma}{2\pi V_\infty}\right)^2 \frac{\rho^2(\rho^2 - r_o^2)}{\left[\rho^2 + r_o^2 - 2r_o\rho\cos(\theta - \phi)\right]\left(\rho^4 + r_o^4 - 2r_o^2\rho^2\cos 2\phi\right)}$$

(B.25)

To allow calculation of the contribution to pressure of the squared terms, we need v. Now,

$$v = \frac{\partial\phi_w}{\partial y} = \frac{\partial\phi_w}{\partial\theta}\frac{\partial\theta}{\partial y}\bigg|_{r_o} = -\frac{1}{2r_o\sin\theta}\frac{\partial\phi_w}{\partial\theta} \qquad \text{(B.26)}$$

so

$$\frac{v}{V_\infty} = \left(\frac{\Gamma}{2\pi V_\infty}\right)\left(\frac{1}{2r_o\sin\theta}\right)\left\{\frac{(\rho^2 - r_o^2)}{\left[r_o^2 + \rho^2 - 2r_o\rho\cos(\theta - \phi)\right]} - 1\right\} \qquad \text{(B.27)}$$

The relations just derived were used in an illustrative calculation. The case considered was for $y_v/s = 0.5$, $z_v/c = 0.25$. This choice of z_v/c eliminates complications brought about by the use of the potential vortex model, for it removes the vortex core from contact with the wing.

The surface pressure distribution due to vortex bending has been calculated by means of equations (B.25) and the relation

$$C_{p_{u_v}} = -\frac{2u_v}{V_\infty} \qquad \text{(B.28)}$$

The surface pressure distribution associated with $-v^2/V_\infty^2$ as calculated from equations (B.9) and (B.27) has also been determined. The results are shown in figure 19.

It is noted that the surface pressure distribution for vortex bending produces uniformly positive pressure on the upper surface of the right half of the wing with a peak at the lateral vortex position. The distribution due to $-v^2/V_\infty^2$ is negative everywhere; the negative pressure peak is about twice the magnitude of the positive pressure peak, but it is about half the breadth. Thus, these effects are of comparable order.

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