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BY

WILLIAM CHARLES ZALEWSKI

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BY

WILLIAM CHARLES ZALEWSKI

FOR

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ABSTRACT

The dynamics of gas adsorption was studied in an air fluidized bed containing activated alumina particles. The adsorption studies made with a fixed bed and in the transition region between minimum fluidization velocity and 2.0 times minimum fluidization velocity, compliment work done at higher velocities. With adsorption, particle motion controlled the overall dynamics of the fluidized bed. A different approach in applying the two phase fluidization model was necessary to satisfactorily describe unsteady state adsorption in fluidized beds. Experimental and theoretical results were compared in frequency response plots to obtain a rigorous comparison. Good agreement was obtained for flow rates at 1.1, 1.28 and 1.65 times minimum fluidization velocity. Fluidization was found to be incomplete at the lower flow rates.

An adsorbable and non-adsorbable tracer were used in the study, "Freon-12" and helium respectively. The packed bed region was studied to obtain the kinetics of adsorption with "Freon-12". The results using helium tracer were found to be inconclusive in the fluidized bed region. The combination of the mixing model with bypassing, and the adsorption kinetics in a unique fashion, provided theoretical curves consistent with experimental results.

PREFACE

Much progress has recently been made in studying fluidized bed processes. It appears that it will be only a matter of time when design of fluidized bed reactors can be made more accurate. There is still much work to be done so design with slightly complicated reactions, such as heterogeneous catalytic reactions, can be undertaken with a fair degree of accuracy. In this work, a mathematical model was developed which can describe the contacting of gaseous reactant with solid catalyst in the unsteady state.

It is the scope of this dissertation to describe the mathematical model which was applied successfully to predict unsteady-state behavior of gas fluidized beds when adsorption is occurring. It is not yet possible to be all inclusive and state that the procedures proposed will be feasible in all cases, since only a narrow region was studied. However, the results indicate that the same model can be applied at higher fluidization velocities.

ACKNOWLEDGMENTS

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I. INTRODUCTION

Realizing the growing use of fluidized bed processes in industry, many investigations of the behavior of fluidized beds have been made. Much of the earlier work involved finding ways to predict steady-state conversions in fluidized bed reactors. These studies utilized mixing models, backmix studies, and residence time distributions. The kinetics studies were primarily first order or pseudo-first order irreversible reactions.

The trend in the past has been toward the study, in a well fluidized state, to find the residence time distribution of the gas in the bed. Using the distribution or a suitable model, first order irreversible kinetics was introduced to predict steady-state conversions for the reactor. This approach has been questioned when heterogeneous reactions occur since particle behavior was not studied in relation to gas behavior. Still, steady-state behavior was the primary goal of previous investigations.

It was the purpose of this study to find a suitable model which will take into account the contacting of gas and solid and predict the unsteady-state response. This was done by finding the experimental transfer function of the fluidized bed by pulse testing techniques. Mathematical models were hypothesized and their transfer functions were compared with experimental results. When the model exhibited the proper behavior, its parameters were adjusted to match experimental results. These parameters, in turn, were studied to develop reasonable correlations which could be used to predict behavior at other conditions.

The system studied used Alcoa F-1 activated alumina particles fluidized with air. Tracers used for pulse testing were helium and "Freon-12". Flow rates used were .49, .91, 1.1, 1.28, and 1.65 times minimum fluidization velocity. Reactor diameter was six inches and aspect (length/diameter) ratio of the bed was 1.2.

II. BACKGROUND

Early investigations of fluidized beds started with attempts to define the gas flow behavior. Gilliland and Mason[6], using helium tracer in an air fluidized bed of glass particles, found that the gas mixing can be described as a combination of complete mixing and gas bypassing. Their experiments also demonstrated that the gas concentration can be different in the bubbles and in the dense regions. The results of backmixing studies showed that tracer gas could be detected upstream from the point where it was injected. Thus, any model proposed would have to take this reversal of flow into account.

Since there are two types of fluidized beds, particulate and aggregate, which have easily recognizable and different flow patterns, there would have to be two types of classifications of models which would have to be used. With particulate fluidization, each individual particle is independently supported by the fluidizing medium. Some gas-solid systems exhibit particulate fluidization but this behavior is more common with liquid-solid systems. The simple dispersion or the tanks-in-series models have been used to describe flow behavior in these systems.[10]

With aggregate fluidized beds the simple models have not given good results.[2] Two region models have been used with varying degrees of success. These types of models presuppose that flow through a fluidized bed occurs two ways, one through the region created by the bubbles and the other region where the bulk of the particles is present. There is also some degree of interchange between these two regions caused by movement of the gas and by movement of the particles carrying adsorbed and occluded gas. The interchange coefficient has been shown to be higher using conversion data than by using residence time distributions. This tends to indicate that interchange is affected by adsorption on the particles.

Naor and Shinnar,[18] by using a method based on the use of intensity functions, were able to demonstrate that fluidized beds can be represented by a system possessing two parallel pathways with strongly differing residence times. Hence, a two region model seems to be a good choice for aggregate fluidized beds.

Solution of the general equations of the two region model involves the assumption of type of flow in each region. Idealized flows are used to simplify the expression so solutions can be attempted.

The more complicated a flow model, the larger the number of parameters that must be evaluated. The two region model has been studied with varying degrees of complexity and most of these studies are summarized by Levenspiel [10] and Kato and Wen.[8]

Mathematical models which are closely connected to bubble dynamics have been proposed by Orcutt et al.,[19] Davidson and Harrison,[4] Rowe,[22] Murray,[17] Kunii and Levenspiel,[9] and Kato and Wen.[8] These models, however, were derived for the steady state.

Barnstone and Harriot[1] have taken the models of Orcutt, Davidson, and Pigford[19] and extended them to include the unsteady-state response. The models were tested using frequency response techniques with helium tracer. They were able to distinguish between different flow patterns and evaluate the parameters of the models without too much difficulty.

Work with fluidized beds has also been done to predict conversions for chemical reactions in a fluidized bed. The investigators in this area selected a flow model and introduced the kinetics of the reaction they were studying. This usually was a first order or pseudo-first order irreversible reaction. For these studies, operation was at steady state in all cases.

Studies of fluidized beds with reaction have been made by Massimilla and Johnstone,[13] May,[15] Mathis and Watson,[14] and Orcutt et al.[19]

Echigoya et al.[5] have questioned the use of residence time distributions or models which describe the residence time distribution to predict the conversion for heterogeneous reactions in fluidized beds. It has been suggested that a contact time distribution would be more appropriate since the reactants must contact the solid in order to react. They conducted experiments with adsorbable and non-adsorbable gases and found that the contact time distribution was indeed different from the residence time distribution and that the mean contact time was shorter than the mean residence time. Their predicted conversions using the experimentally derived contact time distribution showed excellent agreement with experimental conversions.

Yoshida and Kunii[23] used adsorbable and non-adsorbable gases and, using Kunii and Levenspiel's model,[9] were able to predict, reasonably well, the gas residence time distribution when either type of gas was used. Miyauchi et al.[16] used adsorbable and non-adsorbable gases in a gas fluidized bed to develop a good correlation for dispersion coefficients.

From the study of the work of previous investigators, a fluidized bed model can be hypothesized which can explain the behavior of fluidized beds in unsteady-state operation. This model would have the following characteristics:

1. The model would be composed of two regions, a bubble region and an emulsion region. These regions would have either strongly differing residence times or different flow patterns. The concentrations of a gaseous tracer could be different in the two regions.

2. The bubble region would be described by a flow model which would take into account the mixing of the gas in the bubble with the volume surrounding it, called the bubble cloud.

3. There would be an interchange of material between the bubble cloud and the emulsion region. This would occur because of the concentration difference between the two regions and by movement of the fluidized particles between the two regions. The particles would have occluded material or material adsorbed on the surface.

4. Depending on bubble size and height of bed, a certain amount of gaseous material would bypass the bed.

5. At low fluidization velocities, certain portions of the emulsion phase would become dead space.

III. THEORY

The physical system studied was a six-inch diameter fluidized bed. The concentration changes of a tracer in the gas flowing through the bed and the type of mixing taking place were investigated. If the functional relationship between varying input and output concentrations of the gaseous solution flowing through the bed can be found, the dynamic properties may be determined. This relationship is commonly called the transfer function of the system.[3] A simplified discussion follows describing the method of using pulses to derive the frequency response characteristics of a system.

It will be assumed that the system studied is one whose behavior can be described by linear differential equations with constant coefficients. If the system is one whose behavior can be expressed by an n^{th} order linear differential equation, it can be expressed mathematically as

$$\sum_{k=0}^{n} a_k \frac{d^k}{dt^k}\left[y(t)\right] = x(t) \tag{1}$$

where

a_k - a constant

$y(t)$ - output variable as a function of time

$\frac{d^k}{dt^k}$ - k^{th} derivative of the output variable as a function of time

$x(t)$ - input variable as a function of time

If the input variable is a constant, then steady-state conditions would exist. The derivatives would equal zero and a steady-state value of output would be attained.

Thus:

$$y(t)_{s.s.} = \frac{1}{a_o} x_{s.s.} = \text{ a constant} \tag{2}$$

When the input variable is a function of time, that is, $x = x(t)$, then

$$\sum_{k=0}^{n} a_k \frac{d^k}{dt^k}\left[y(t)\right] = x(t) \tag{3}$$

Applying the Laplace transform with respect to time and assuming initially that the first n-1 derivatives of the variable y(t) are equal to zero, the above equation becomes:

$$\left(\sum_{k=0}^{n} a_k s^k\right) Y(s) = X(s) \tag{4}$$

where

$$Y(s) = \int_0^\infty e^{-st}\, y(t)\; dt$$

$$X(s) = \int_0^\infty e^{-st}\, x(t)\; dt$$

The ratio of the output function to the input function is called the transfer function which is defined as:

$$\frac{Y(s)}{X(s)} = \frac{\int_0^\infty e^{-st}\, y(t)\, dt}{\int_0^\infty e^{-st}\, x(t)\, dt} = T.F. \qquad (5)$$

If x(t) and y(t) are piecewise continuous functions which depict bounded variations of process variables which return to their initial values after a finite length of time and remain there, then these functions may be called pulses. The integrals can have different upper limits but still will exist.

$$T.F. = \frac{\int_0^{T_y} e^{-st}\, y(t)\, dt}{\int_0^{T_x} e^{-st}\, x(t)\, dt} \qquad (6)$$

where

T_y - duration time of the output pulse

T_x - duration time of the input pulse

By replacing s by iw, where i is $\sqrt{-1}$, the steady state response of the system to a sinusoidally varying input of frequency w can be found. The transfer function becomes

$$T.F.(iw) = \frac{\int_0^{T_y} e^{-iwt} y(t)\, dt}{\int_0^{T_x} e^{-iwt} x(t)\, dt} \tag{7}$$

Applying Euler's relationship

$$e^{-iwt} = \cos wt - i \sin wt \tag{8}$$

The transfer function in the frequency domain becomes

$$T.F.(iw) = \frac{\int_0^{T_y} y(t) \cos wt\, dt - i \int_0^{T_y} y(t) \sin wt\, dt}{\int_0^{T_x} x(t) \cos wt\, dt - i \int_0^{T_x} x(t) \sin wt\, dt} \tag{9}$$

One of the methods described by Clements and Schnelle[3] has been widely used to obtain system transfer functions from pulse testing data. The TAFT method, as it is sometimes called, evaluates the transfer function by evaluating the integral above numerically using a quadrature formula. Hays et al.[7] have presented a method which is more efficient and more flexible. It involves evaluating the equations describing the pulse and performing the integration analytically.

Assume the pulse, f(t), can be represented by a function made up of a series of polynomial segments. Ordinary discontinuities are allowed in the function and its derivatives at the union of the segments. The equation of this function can be represented using a series of the form

$$f(t) = \sum_{j=1}^{n} u(t-T_j)\left[A_j + B_j(t-T_j) + \frac{C_j(t-T_j)^2}{2!} + \frac{D_j(t-T_j)^3}{3!} + ----\right] \qquad (10)$$

The notation $u(t-T_j)$ represents the unit step function. A_j is the change in the value of the function at the boundary between the interval T_{j-1} and T_j, B_j is the change of the value of the first derivative, C_j is the change of the value of the second derivative, etc.

The Laplace transform with respect to time of the above equation is

$$F(s) = \sum_{j=1}^{n} \left[\frac{A_j}{s} + \frac{B_j}{s^2} + \frac{C_j}{s^3} + \frac{D_j}{s^4} + \cdots\cdots \right] e^{-T_j s} \tag{11}$$

If the function f(t) is Fourier transformable, iw can be substituted for s to give the Fourier transform

$$F(iw) = \sum_{j=1}^{n} \left[\frac{A_j}{iw} + \frac{B_j}{-w^2} + \frac{C_j}{(iw)^3} + \frac{D_j}{w^4} + \cdots\cdots \right] e^{-iwT_j} \tag{12}$$

Applying Euler's relationship

$$e^{-iwt} = \cos wt - i \sin wt \tag{13}$$

F(iw) can be written in terms of its real and imaginary parts

$$R(w) = \sum_{j=1}^{n} \left[-\frac{A_j}{w} + \frac{C_j}{w^3} - \cdots\cdots \right] \sin wT_j$$

$$+ \left[-\frac{B_j}{w^2} + \frac{D_j}{w^4} - \cdots\cdots \right] \cos wT_j \tag{14}$$

$$I(w) = \sum_{j=1}^{n} \left[-\frac{A_j}{w} + \frac{C_j}{w^3} - \cdots\cdots \right] \cos wT_j$$

$$- \left[-\frac{B_j}{w^2} + \frac{D_j}{w^4} - \cdots \right] \sin wT_j \tag{15}$$

where

$$F(iw) = R(w) + i\, I(w) \tag{16}$$

The above technique was used to evaluate the Fourier transform of the input and outlet pulses. A computer program, DPLS, was written which would evaluate the data using step, straight and parabolic segments to describe the pulse. The use of straight line segments was found to be best suited for the type of pulses used in the experiments.

The computer program was tested by using functions where the frequency response characteristics were known. It was found that the step approximation to the curves gave results which were similar to those given by the TAFT method. The use of straight line segments produced the closest fit in approximating the shape of the curves. Approximating the shape of the curve with parabolic segments gave results similar to those using straight line segments at low frequencies. At high frequencies the results became erratic. It was determined that the use of the second derivatives, which were necessary with parabolic segments, were causing the erratic results.

The transfer function is a complex number which can be represented vectorially in the complex plane by a magnitude and an angle measured with respect to the positive real axis for any value of w. It is convenient to display the transfer function on logarithmic coordinates, two graphs being required. One is a graph of the logarithm of the magnitude of the transfer function versus the logarithm of frequency. The other is a graph of the angle or phase versus the logarithm of frequency. The combination of the two graphs is called the Bode diagram of the transfer function.

The Bode diagram drawn from the results of pulse testing is exactly similar to one drawn from the results of direct frequency response measurements. By introducing a sinusoidally varying input to the system, the system being linear, a sinusoidally varying output of the same frequency as the input will be present when transient conditions have vanished. The ratio of the amplitude of the output wave to the input is the magnitude ratio, which is equivalent to the magnitude ratio of the transfer function at the same frequency given by pulse testing. The magnitude ratio is also called the amplitude ratio. The phase difference between the input and output waves by direct testing is equivalent to the angle given by pulse testing. This angle is commonly called the phase angle.

The magnitude ratio and phase angle derived from pulse testing are

$$M.R. = \sqrt{[R(w)]^2 + [I(w)]^2} \tag{17}$$

$$\phi = \text{phase angle} = \tan^{-1} \frac{I(w)}{R(w)} \tag{18}$$

To determine the transfer function from experimental data, the one sided Fourier integrals must be evaluated. The function x(t) describes the pulse put into the fluidized bed. Since this study utilized concentration changes, the pulse was a deviation from the initial concentration of tracer (namely zero concentration) in the inlet air to the bed. When the pulse was introduced, there was a delay before the concentration change was detected at the top of the bed. The delay was caused by the lag in the outlet sampling device and the time it took the tracer to travel through the bed. The delay from the sampling device was subtracted from the total delay time giving the delay time caused by the bed.

The delay time in the bed is part of the transfer function of the bed. However, in the analysis of the experimental pulses, it may be treated separately. If the input variable is x(t), then the output can be expressed as $y(t) = z(t - L)$ where L is the delay time. See Figure No. 1. $t' = 0$ would express the origin moved L time units to the right of $t = 0$.

The delay time delays the function in time without otherwise altering it. Using the Laplace transform

$$Y(s) = \int_0^\infty z(t-L)\, e^{-st}\, dt \tag{19}$$

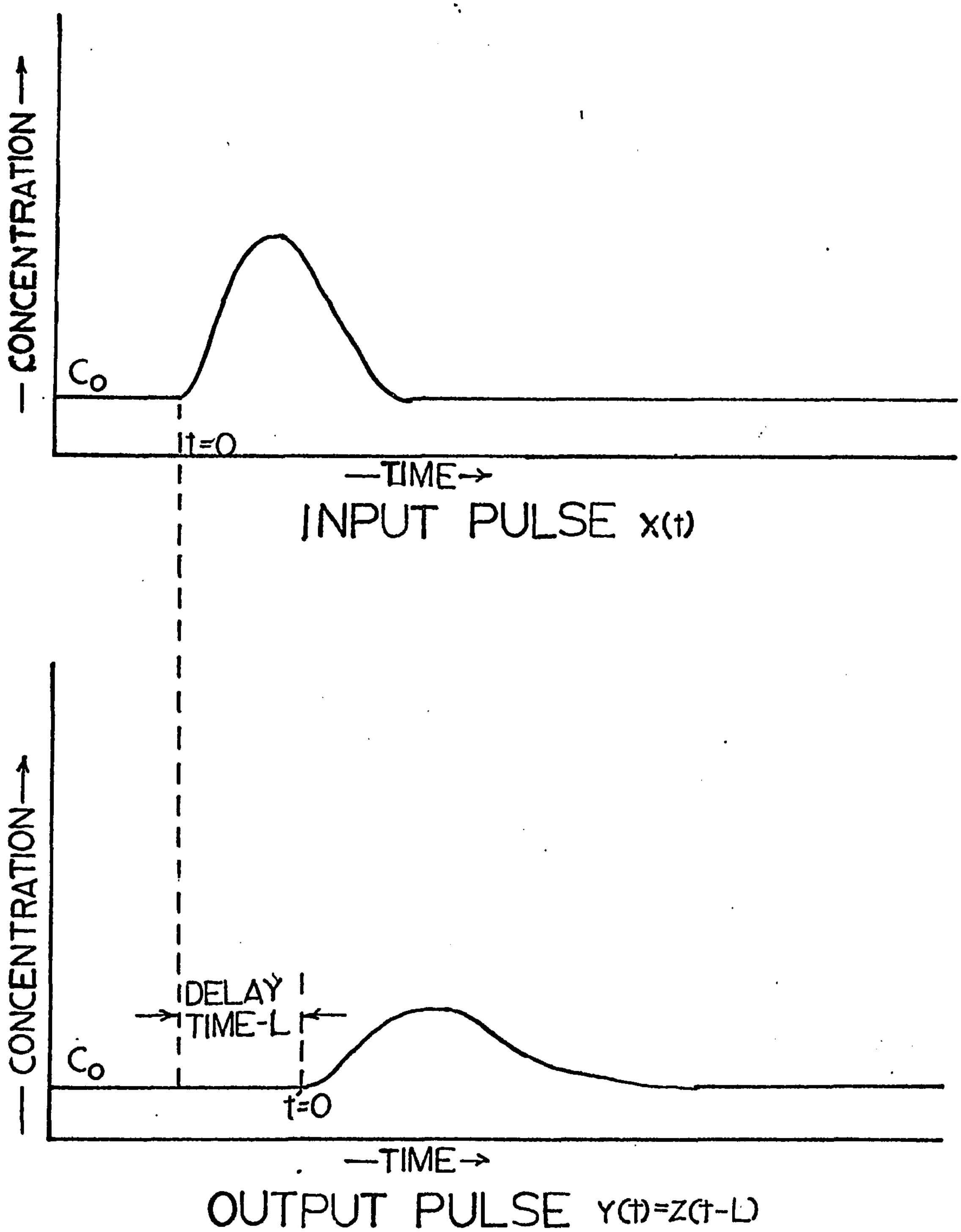


FIGURE I PULSES

where

$$Z(t') = 0 \quad \text{for } t' < 0$$

Changing the variable under the integral sign by replacing (t -L) by t':

$$Y(s) = \int_0^\infty Z(t')\, e^{-s(t'+L)}\, d(t'+L) \tag{20}$$

where t and t' are values of time measured from different origins L time units apart on the abscissa.

Since L is constant

$$Y(s) = e^{-Ls} \int_0^\infty e^{-st'} Z(t')\, dt' \tag{21}$$

By the definition of the Laplace transform

$$Y(s) = e^{-Ls}\, Z(s) \tag{22}$$

Since the transfer function is expressed as

$$T.F. = \frac{Y(s)}{X(s)} \tag{23}$$

delay time can be treated separately and

$$T.F. = e^{-Ls}\,\frac{Z(s)}{X(s)} = G_d\,\frac{Z(s)}{X(s)} \tag{24}$$

Treating the dead time element G_d separately s is replaced by iw

$$G_d = e^{-iwL} \tag{25}$$

Applying Euler's relation, the magnitude ratio of the dead time element is

$$M.R. = \sqrt{\cos^2 wL + \sin^2 wL} = 1 \tag{26}$$

The phase angle contribution of the dead time element is

$$\phi = \tan^{-1}\left[\frac{-\sin wL}{\cos wL}\right] = -wL \tag{27}$$

Since the magnitude ratio is one, dead time has no effect on the magnitude ratio of the measured transfer function. It has the characteristic of a pure phase shift.

After the pulse is introduced into the fluidized bed, the delay will occur and then the output concentration will deviate from initial conditions to return after a finite length of time. This deviation is the output pulse and is defined as z(t). To obtain the transfer function of the system, the integrals in (9) must be evaluated from the experimental data; that is, the input and output histories of concentration must be observed.

Based on the previous discussion of the dead time element ending with equations (26) and (27), the altitudes of the input and output pulses were read using different time origins. The values for $t = 0$ (input pulse origin) and $t' = 0$ (output pulse origin) were chosen at the points where the measured altitude deviated from the base line. The dead time was then treated separately by measuring L which was defined by

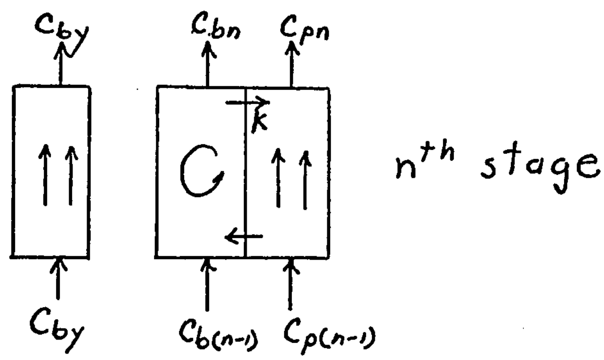
$$L = \left[\frac{\text{time origin for output pulse}}{t' = 0}\right] - \left[\frac{\text{time origin for input pulse}}{t = 0}\right] \tag{28}$$

The computer program, DPLS, calculated the values of the frequency response curves without the dead time correction and with the dead time correction. In the event that the measured dead times had to be adjusted, the corrections in the phase angle could be made without the use of the computer.

The fit of the transfer function in the frequency domain would be preferred to the fit of responses in the time domain because the effect of the phase angle is taken into account. To evaluate the parameters in a distributed parameter system, the method of moments is normally used.[7] This method has two important disadvantages. First, numerical errors associated with the computation of moment can be large since they weigh heavily the tail portion of the experimental time curve. The measured curves are least accurate in the tail portion. Second, the applicability of a theoretical model cannot be determined using the method of moments. The effect of each parameter in the theoretical model is more easily determined in the frequency domain than in the time domain.

For complicated models the predicted response $y_p(t)$ may be very difficult to find if a fit in the time domain were attempted. A numerical technique is necessary to obtain $y_p(t)$ from the frequency domain and introduces error.

The mixing model used is the two phase mixing model with bypassing. It was formulated using a staging procedure to predict operation of fluidized beds with high aspect ratios.



The model is composed of three regions, an idealized plug flow region, an ideal completely mixed region, and a bypass region. The model is a modification of a model described by Barnstone and Harriot.[1]

Before formulating the mathematics, it is necessary to provide the background which has gone into developing this model. Davidson and Harrison[4] have determined theoretically and experimentally that there exists a volume outside the rising bubble which is affected by the bubble which has been defined as a cloud. Within the bubble and cloud, the gas circulates in a circular pattern. The volume of the cloud with relation to bubble size is dependent on bubble diameter and minimum fluidization velocity. This cloud and a portion of the bubble volume will be considered the lean phase. The remainder of the bed where solids are present will be the dense phase.

The following conditions have been noted in fluidized beds:

1. At minimum fluidizing conditions, the solids are relatively quiescent. The only noticeable mixing occurs around the vicinity of the rising bubbles. Around minimum fluidizing conditions, a portion of the bubble and all of the cloud volume would be considered completely mixed. Gas bypassing the bed will be through the remaining portion of the bubble volume. The dense phase will be considered to be operating in a plug flow condition.

2. At higher gas velocities, the rising bubbles cause the observed mixing and flow of solids. At these flows there is much more mixing occurring. This mixing should be apparent by an increase in the fraction of bed completely mixed, with a corresponding decrease in plug flow volume. If reaction or adsorption is taking place, the contacting efficiency of the plug flow region will also decrease due to particle motion in this region.

The dense phase will always be considered operating at minimum fluidization conditions, i.e. superficial gas velocity through the dense phase and porosity will be at u_{mf} and ϵ_{mf} respectively.

The following quantities are also defined:

$$\gamma_\ell = \frac{\text{volume of solids in lean phase}}{\text{volume of lean phase}} \tag{29}$$

$$\gamma_d = \frac{\text{volume of solids in dense phase}}{\text{volume of dense phase}} \tag{30}$$

A theoretical correlation exists from Davidson and Harrison's work[4] for γ_ℓ but this is for a single bubble. Experimental evidence indicates that the volume fraction of solids calculated for single bubbles is less than that for beds with coalescence of bubbles taking place. Hence, the theoretical volume fraction would give a lower limit for volume fractions of solids in the lean phase.

In developing the model, a material balance is necessary for gas flow through the various phases.

$$V_p u_p + V_b u_b + V_{by} u_{by} = u \tag{31}$$

where

$\bar{V}_p$ - volume fraction of bed in plug flow

$\bar{u}_p$ - superficial velocity through the plug flow region, ft/sec.

u - overall superficial velocity into the bed, ft/sec.

V_b - volume fraction of bed in backmix flow

u_b - superficial velocity through the backmix flow region, ft/sec.

v_{by} - volume fraction of bed bypassed

u_{by} - velocity through bypass region, ft./sec.

The material balance per unit volume of bed per stage

<u>Plug Flow Phase - nth Stage</u>

$$\begin{bmatrix}\text{Accumulation of}\\ \text{material}\end{bmatrix} = \begin{bmatrix}\text{Material transferred}\\ \text{from backmix phase}\end{bmatrix} + \begin{bmatrix}\text{Input of}\\ \text{material}\end{bmatrix} - \begin{bmatrix}\text{Output of}\\ \text{material}\end{bmatrix} - \begin{bmatrix}\text{Material adsorbed}\\ \text{on catalyst}\end{bmatrix} \quad (32)$$

<u>Backmix Phase - nth Stage</u>

$$\begin{bmatrix}\text{Accumulation of}\\ \text{material}\end{bmatrix} = \begin{bmatrix}\text{Input of}\\ \text{material}\end{bmatrix} - \begin{bmatrix}\text{Output of}\\ \text{material}\end{bmatrix} + \begin{bmatrix}\text{Material transferred}\\ \text{from plug flow phase}\end{bmatrix} - \begin{bmatrix}\text{Material}\\ \text{adsorbed on}\\ \text{catalyst}\end{bmatrix} \quad (33)$$

<u>Plug Flow Phase - nth Stage</u>

$$(1-\gamma_p) V_p \frac{\partial C_{pn}(t,z)}{\partial z} = k\left[C_{bn}(t) - C_{pn}(t,z)\right] - V_p u_p \frac{\partial C_{pn}(t,z)}{\partial z} - \gamma_p V_p E_p \frac{\partial Q_p}{\partial t} \quad (34)$$

<u>Backmix Phase - nth Stage.</u>

$$(1-\gamma_b) V_b \frac{d \bar{C}_{bn}(t)}{d t} = \frac{V_b u_b}{Z} \left[C_{fb}(t) - \bar{C}_{bn}(t) \right] + \frac{1}{Z} \int_0^Z k \left[C_{pn}(t,z) - \bar{C}_{bn}(t) \right] dz$$

$$- E_b \gamma_b V_b \frac{\partial \bar{Q}_b(t)}{\partial t} \qquad (35)$$

where

$\bar{C}_{bn}(t)$ - concentration of tracer in backmix phase in the nth stage

$\bar{\gamma}_p$ - volume fraction solids in plug flow phase

$C_{pn}(t,z)$ - concentration of tracer in plug flow phase in nth stage

k - interchange coefficient to account for tracer interchange between phases

z - height in the stage

Q_p - weight of tracer adsorbed per unit volume of catalyst in plug flow phase

γ_b - volume fraction solids in backmix phase

Z - total height of stage

C_{fb} - concentration of tracer entering backmix region from previous stage

Q_b - weight of tracer adsorbed per unit volume of catalyst in backmix phase

$\mathcal{E}_p$ - catalyst contact efficiency in plug flow phase

$\mathcal{E}_b$ - catalyst contact efficiency in backmix phase

The exit concentration of the bed will be given by

$$\begin{bmatrix}\text{Overall}\\\text{response}\end{bmatrix} = \begin{bmatrix}\text{Fraction of total}\\\text{flow in}\\\text{backmix flow}\end{bmatrix} \times \begin{bmatrix}\text{Backmix phase}\\\text{response}\end{bmatrix} + \begin{bmatrix}\text{Fraction of total}\\\text{flow in}\\\text{plug flow}\end{bmatrix} \times \begin{bmatrix}\text{Plug flow}\\\text{response}\end{bmatrix} + \begin{bmatrix}\text{Fraction of total}\\\text{flow in}\\\text{bypass}\end{bmatrix} \times \begin{bmatrix}\text{Bypass}\\\text{response}\end{bmatrix} \quad (36)$$

$$C(s) = \frac{V_b u_b}{u} C_{bm}(s) + \frac{V_p u_p}{u} C_{pm}(s, Z_m) + \frac{V_{by} u_{by}}{u} C_{by}(s) \quad (37)$$

where s is the Laplace transform operator and bypass response is the pure dead time element.

The following are defined:

B_p - fraction of total flow in plug flow phase

B_y - fraction of total flow in the bypass region

V_{by} - volume fraction of bed in bypass region

u_{by} - velocity in bypass region

Z_m - height of the last stage

Therefore from (37)

$$C(s) = (1-B_p-B_y)\, C_{bm}(s) + B_p\, C_{pm}(s, Z_m) + B_y\, C_{by}(s) \tag{38}$$

Taking the Laplace transform of (33) where

$$C_{pn}(0,z) = C_{bn}(0) = Q_p(0) = 0 \tag{39}$$

and

$$Q_p(s) = Y_p(s)\, C_{pn}(s,z) \tag{40}$$

and solving (37) with the boundary conditions:

$$@\ z=0 \qquad C_{pn}(t,0) = C_{fp}(t)$$

$$C_{pn}(s,0) = C_{fp}(s)$$

the following equation is obtained:

where $$\alpha = \frac{(1-\gamma_p)s}{u_p} + \frac{E_p \gamma_p Y_p(s)}{u_p} + \frac{k}{V_p u_p}$$

$$C_{pn}(s,z) = C_{fp}(s)\exp(-\alpha z) + \frac{k}{V_p u_p \alpha} C_{bn}(s)\left[1-\exp(-\alpha z)\right] \qquad (41)$$

Substituting this result into (35) for the backmix phase after the Laplace transform has been found and solving, the result is shown in Table I, where

C_{fp} - concentration of tracer entering plug flow phase from previous stage

$\mathcal{A}$ - $(1-\gamma_p)s + \gamma_p Y_p(s) E_p$

T_p - V_p/k

$H(s)$ - $\exp-(L_p \mathcal{A} + N)$

T_{vb} - $V_b Z/u$

T_{vp} - $V_p Z/u$

L_p - Z/u_p

N - $kZ/V_p u_p$

Y_b - complex adsorption admittance for backmix region

Y_p - complex adsorption admittance for plug flow region

TABLE I

MODEL EQUATIONS

Laplace Transform of the Response of the Backmix Phase

$$C_{b_n}(s) = \frac{(1-\beta_p-\beta_y)\,C_{fb}(s) + \dfrac{\beta_p\,C_{fp}(s)}{T_p s+1}\Big[1-H(s)\Big]}{(1-\gamma_b)\,T_{vb}\,s + 1 - \beta_y + \dfrac{T_{vp}\,s}{T_p s+1} - \dfrac{\beta_p(T_p s+2)\,T_p s}{(T_p s+1)^2} - \dfrac{\beta_p\,H(s)}{(T_p s+1)^2} + E_b\,T_{vb}\,\gamma_b\,Y_b(s)} \tag{42}$$

Laplace Transform of the Response of the Plug Flow Phase

$$C_{pn}(s,z) = C_{fp}(s)\,H(s) + \frac{1}{T_p s+1}\Big[1-H(s)\Big]\,C_{b_n}(s) \tag{43}$$

From (41) the Laplace transform at the plug flow phase is shown in Table I. From (43), (42), and (38), the Laplace transform of the exit concentration of the bed is given by

$$C(s) = (1 - \beta_p - \beta_y) C_{bm}(s) + \beta_p C_{pm}(s, Z_T) + \beta_y C_{by}(s) \tag{44}$$

The adsorption terms Q_p and Q_b will be derived according to the method described by Rosen.[21] Assume adsorption occurs like a first order chemical reaction

$$\frac{\partial Q}{\partial t} = k_1 C - k_2 Q \tag{45}$$

Applying this equation to the theoretical model $\partial Q / \partial t$ would be independent of its position in the bed. Equilibrium is considered to be unhampered by film coefficients or diffusion. Therefore,

$$\frac{dQ}{dt} = k_1 C - k_2 Q \tag{46}$$

Taking the Laplace transform

$$s\,Q(s) = k_1 C(s) - k_2 Q(s) \tag{47}$$

Rearranging

$$Q(s)\,(s+k_2) = k_1\,\mathcal{C}(s) \tag{48}$$

$$Q(s) = \frac{k_1\,\mathcal{C}(s)}{s+k_2} \tag{49}$$

Therefore,

$$\mathcal{L}\left[\frac{dQ}{dt}\right] = Q(s)\,s = \left[\frac{k_1 s}{s+k_2}\right]\mathcal{C}(s) \tag{50}$$

The value

$$\frac{k_1 s}{s+k_2} = Y'(s) = \text{admittance caused by adsorption} \tag{51}$$

There were two types of flow patterns studied with the dense phase in plug flow:

1. High flow rates with bypassing gas where

$$\begin{aligned} u_p &= u_{mf} \\ \gamma_p &= \gamma_{mf} \end{aligned} \tag{52}$$

The bypassing gas is assumed to occur through the bubble so the velocity of bypassing gas is assumed to be at the velocity of the bubble. The volume fraction of the bed as bubbles is given by

$$V_v = \frac{Z_T - Z_{mf}}{Z_T} \tag{53}$$

Making a material balance

$$u_v V_v = u - u_d V_d \tag{54}$$

Since there are tworegions assumed in the bed with the dense region at minimum fluidization conditions

$$u_v V_v = u - u_{mf}(1 - V_v) \tag{55}$$

Therefore

$$u_v = \frac{u - u_{mf}}{V_v} + u_{mf} \tag{56}$$

The transport lag of the bypass phase is then

$$L_V = \frac{Z_T}{u_V} \tag{57}$$

Utilizing conservation of the volume of catalyst and making a material balance.

$$S\, Z_T V_p \gamma_p + S\, Z_T V_b \gamma_b = S\, \gamma_{mf} Z_{mf} \tag{58}$$

$$\gamma_b = \frac{\gamma_{mf}}{V_b} \left[\frac{Z_{mf}}{Z_T} - V_p \right] \tag{59}$$

2. Low flow rates with bypassing gas and a dead zone in the dense phase.

If D_V is the dead volume fraction, the material balance for catalyst is

$$S\, Z_T D_V \gamma_V + S\, Z_T V_p \gamma_p + S\, Z_T V_b \gamma_b = \gamma_{mf} S\, Z_{mf} \tag{60}$$

$$\gamma_b = \gamma_{mf} \tag{61}$$

$$\gamma_V = \frac{\gamma_{mf}}{D_V}\left[\frac{Z_{mf}}{Z_T} - V_p - V_b\right] \tag{62}$$

By proper combination of the above equations for the cases studied, the theoretical transfer function of the fluidized bed can be found. By substituting iw for s and programming the equations on the computer using complex number routines available in FORTRAN IV, the frequency response characteristics of the models were plotted and compared to the experimental data. The computer program was named MOD.

IV. EXPERIMENTAL APPARATUS

Figure 2 is a diagram of the apparatus used for the tests. The reaction chamber was a glass pipe six inches in diameter and three feet high. The top cover was made from one-half inch thick plexiglass. It had a tap for one leg of a water manometer and a slip joint for the outlet sampling tube. Exhaust air passed through a one-inch pipe threaded to the center of the cover and was vented outside the building.

Figures 3 and 4 illustrate the design of the air distributor and calming section. The distributor had nineteen one-eighth inch diameter orifices covered by one-inch diameter disks primarily to prevent the flow of catalyst into the calming section when air flow stopped. Under two caps were the sample inlets, one for the other leg of the manometer and the second for the inlet sample. By placing these sample points under the caps, the concentration measurements and the pressure drops could be made directly across the bed. This avoided the error caused by measuring both the pressure drop and dynamic response over the entire reactor and then correcting for the pressure drop and dynamics of the distributor and calming section.

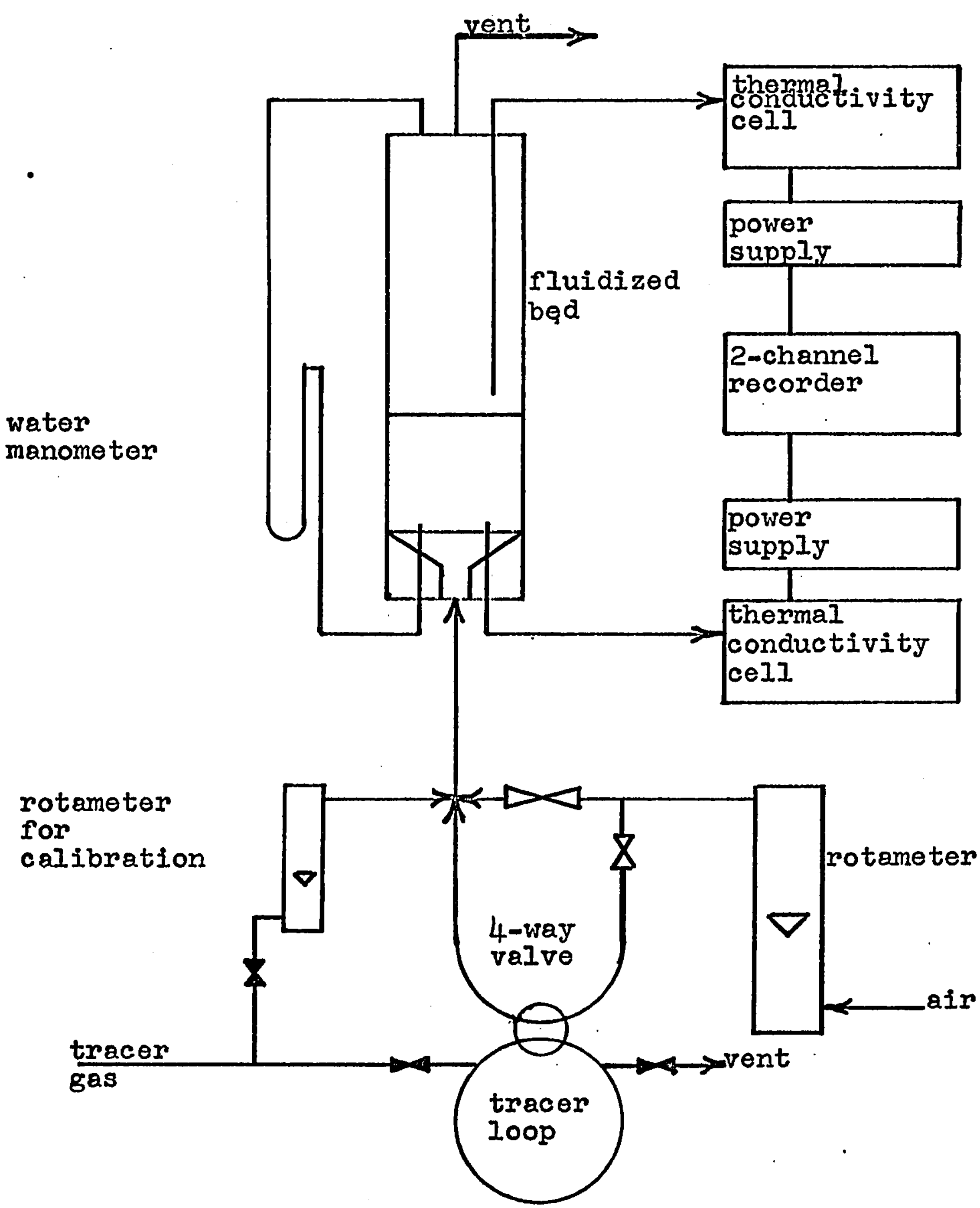


FIGURE 2 EXPERIMENTAL APPARATUS

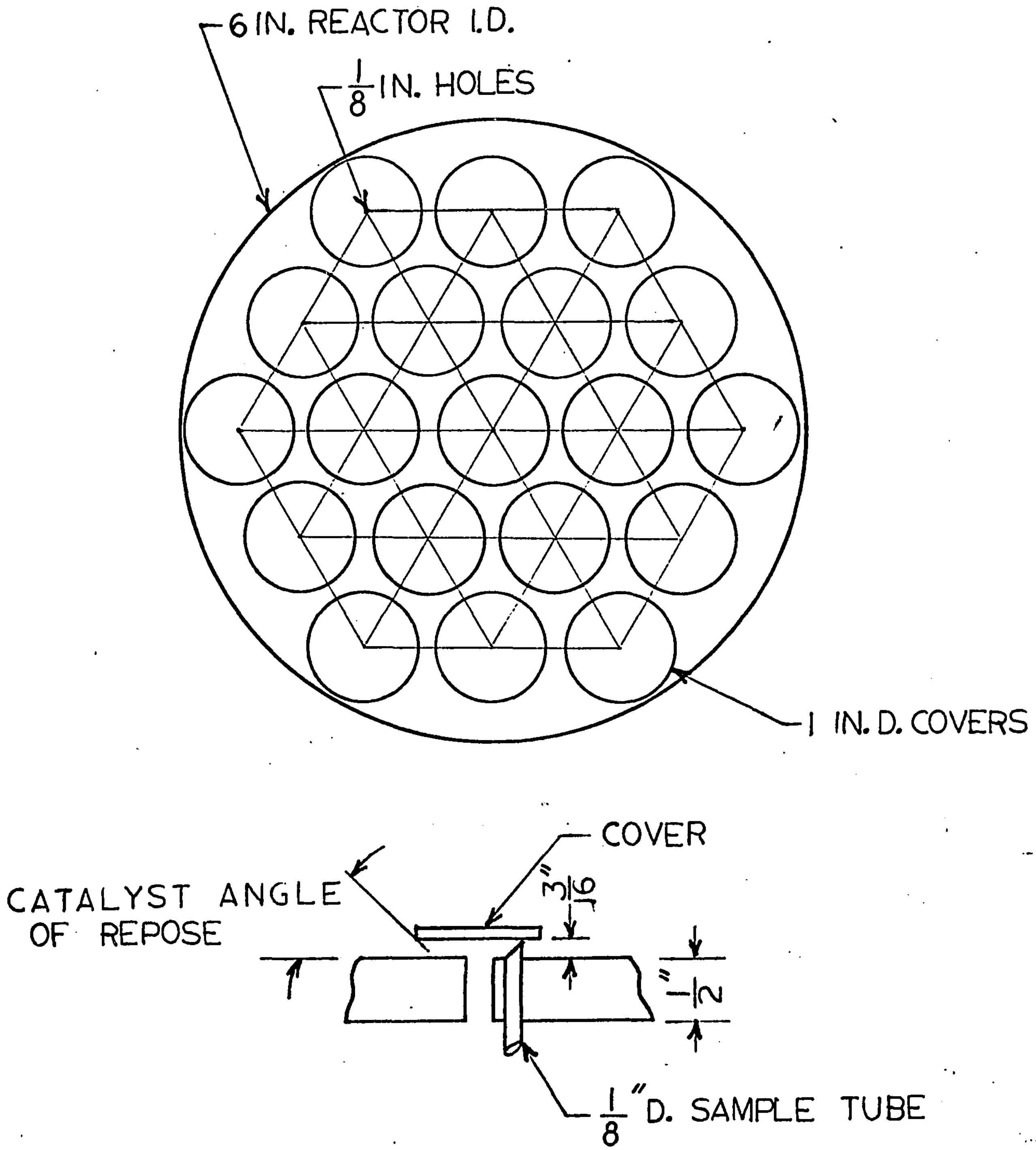


FIGURE 3 DISTRIBUTOR DETAILS

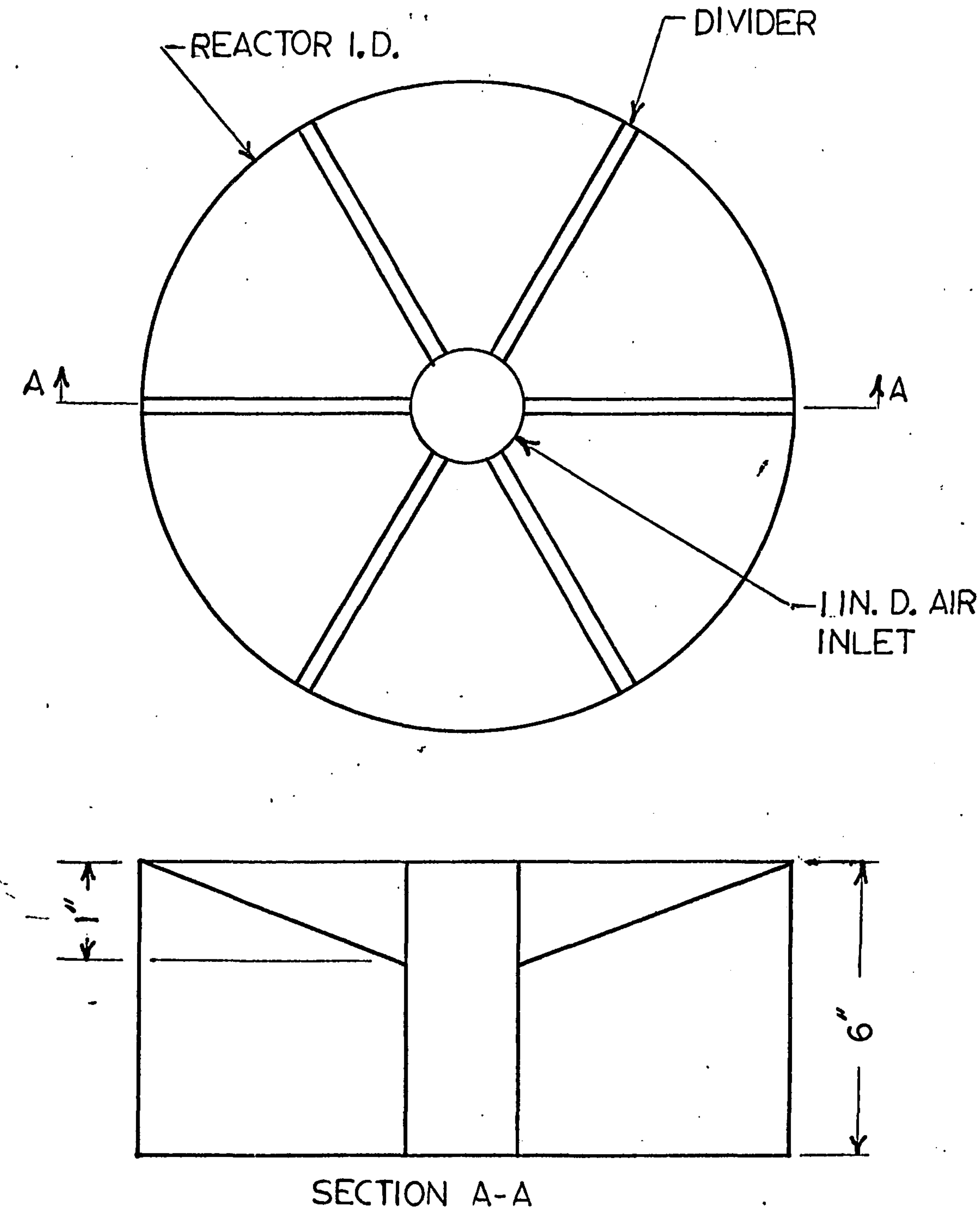


FIGURE 4 CALMING SECTION DETAILS

Bed packing was Alcoa F-1 activated alumina, 28-35 mesh. Fluidizing gas was air and tracer gas was either helium (non-adsorbing) or "Freon-12" (absorbing).

One-eighth inch outside diameter copper tubing was used for the sample lines. No filters were used on the ends of the tubes because these caused unnecessary sampling lags and mixing in the sampling lines. Catalyst particles were not carried into the sampling lines because the sample flow in the outlet sample line was below settling velocity of the particles. The inlet sample line was shielded by the caps to prevent flow of catalyst into the tubing.

Details of one sampling system are in Figure 5. Gow-Mac Model #10-777 thermal conductivity cells were used to detect the tracer gases, "Freon-12" and helium in the air stream. The detectors are a semi-diffusion type utilizing thermistor detector elements. The semi-diffusion type cell was found to give fast response with a high signal to noise ratio.

Originally, flow-through detectors were used which gave faster response but their high sensitivity to flow fluctuations made them impractical to use. Also with the low sampling rates necessary with this type of cell (10 cc/min.) the time lag of the system and undesirable dynamics made these cells unsuitable.

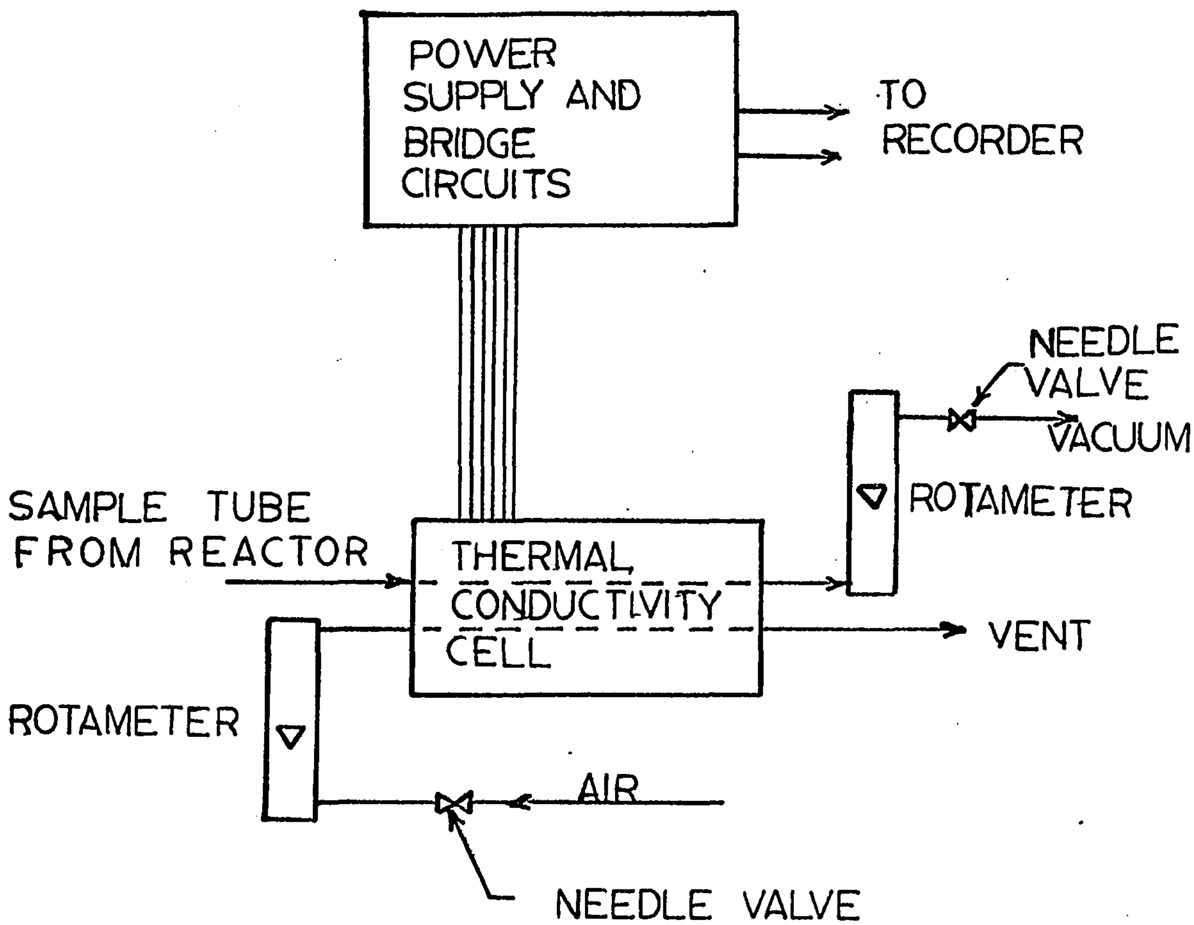


FIGURE 5

FLOW DIAGRAM OF SAMPLING CIRCUITS

With the use of semi-diffusion type cells, the sampling rate could be considerably higher (100 cc/min.) and the signal was not sensitive to minor flow fluctuations. The response characteristics of both inlet and outlet sampling systems were studied and it was determined that corrections in the dynamics other than lag time would not have to be made to the overall response characteristics of the catalyst bed.

Samples were drawn through the cells using a small sampling pump. The cells were connected to Gow-Mac Model #9999-D power supply units. The power supplies provided the proper balancing and had provision for a recorder hookup. D.C. power was supplied by a 12-volt automobile battery to provide noise-free signals. The internal power supply of the Gow-Mac power supply had too much ripple to be used with the recorder at the high sensitivities used. See Figure 6 for an electrical schematic of the power supply.

The recorder was a two-channel Brush Clevite Model #240 pen recorder. Channel widths were 80 mm with rectilinear motion ink pens. The wide channel provided good resolution for reading the curves.

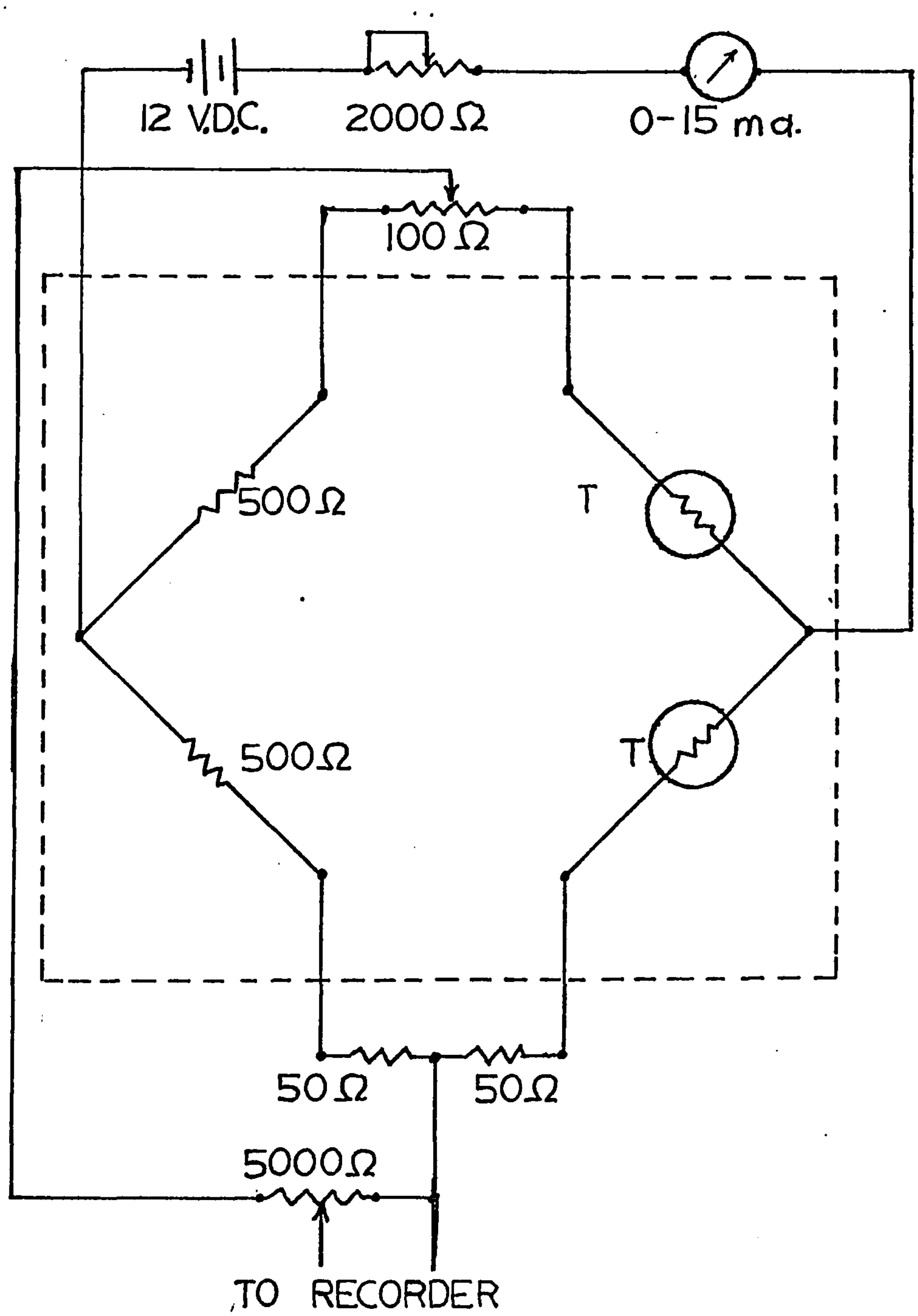


FIGURE 6 THERMISTOR CELL CIRCUIT

Air was supplied to the test apparatus by a compressor at 45 psig at a maximum flow of 10 SCFM. Pressure was regulated in two stages to 15 psig to minimize pressure fluctuations. A third air regulator was used to supply the reference air to the thermal conductivity cells at a pressure of 0-5 psig.

Six rotameters were used for measuring various gas flows. Four Brooks "Sho-Rate" rotameters (0-150 cc/min.) measured sample and reference flows through the thermal conductivity cells. One measured the main air flow to the bed. The sixth rotameter (0-1500 cc/min.) was used in a calibration piping circuit so calibration curves could be established for the detectors under actual operating conditions. The five smaller rotameters were calibrated using a wet test meter. Equipment was not available to calibrate the large rotameter so the factory calibration curves were used. The factory calibration curves for the other five rotameters were sufficiently accurate to justify confidence in the remaining curve.

The detectors were calibrated at 100 cc/min. sample and reference flows with 7.5 ma. bridge current. Main air flow was set at some convenient value. Helium or

"Freon-12" was then metered into the main air stream. The calibration curves for both detectors was similar and linear. These curves are shown in Figure 7.

Pulse introduction was accomplished using a four-way valve. An air bleed stream normally passed through two ports of the valve. With change of position, the air stream was diverted through a loop previously filled with tracer gas. The tracer was then forced into the main air stream. For different pulse strengths, different lengths of tubing were used in the loop.

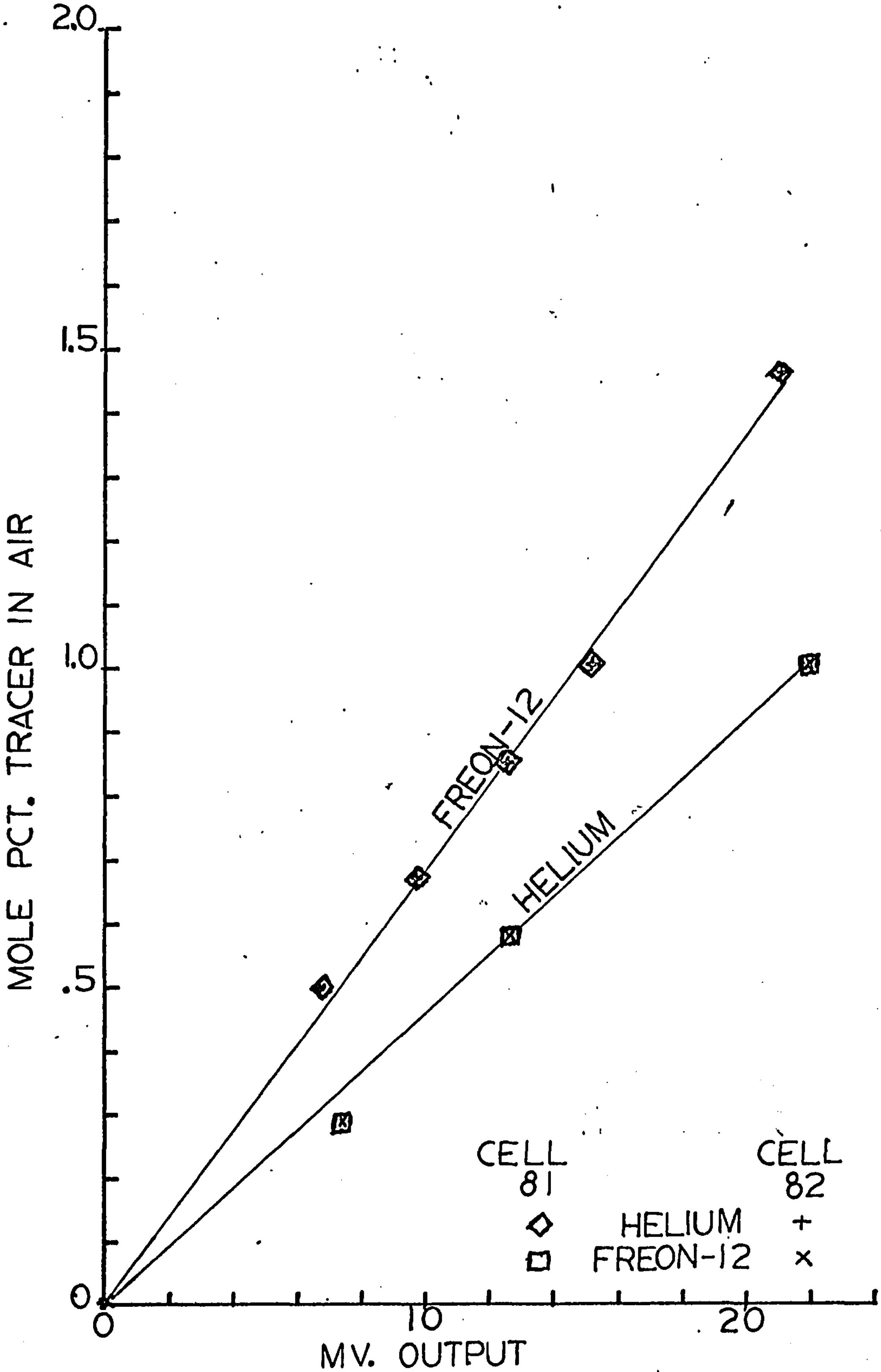


FIGURE 7 CELL CALIBRATION CURVES

V. EXPERIMENTAL PROCEDURE

Minimum fluidization velocity was found by observing bed pressure drop vs air rate. Figure 8 illustrates the results. Bed aspect ratio was 1.2. Tracer tests were performed at five air rates, 0.49, 0.91, 1.1, 1.28 and 1.65 times minimum fluidization velocity.

All tracer tests were duplicated to insure reproductibility in the results. Different pulse strengths were used at each test condition to check for linearity.

Before a series of testing, all flows were set and the sample detection apparatus was allowed to stabilize. When the base lines from the detectors showed no drift, the system was considered ready for testing.

The introduction of tracer was accomplished by first flushing the sample loop with tracer gas and then turning the four-way valve. The inlet and outlet tracer concentrations vs. time were recorded. Changing tracer sample size was just a matter of changing sample loop length. All tests at one flow rate could be performed without disturbing the fluidized bed or any of the control settings.

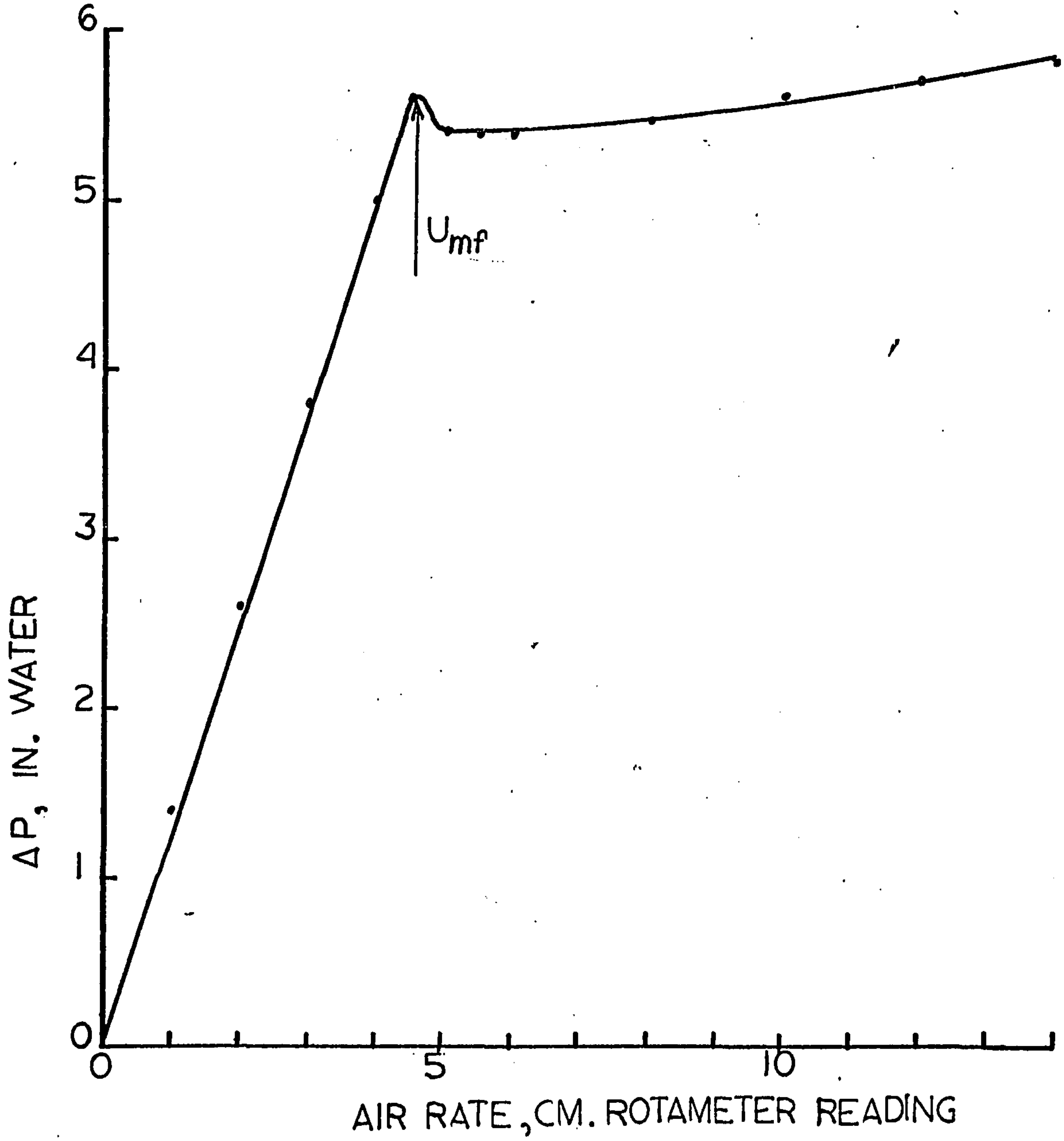


FIGURE 8 ΔP VS. AIR RATE

The date, run number, air flow rate, bed height and recorder sensitivity were noted on the recorder chart. Chart speed was 10 mm/sec.

A delay will exist because the tracer must travel through the bed and the sample lines. The delay in the sample lines is known to within a second. Since the chart paper was travelling at a constant speed, all that was needed to measure the lag time in the bed was to use a ruler to measure the distance, convert to time and subract the sample lag time. This method worked well in the packed bed region.

When the bed was fluidized, the measured lag time in the bed was not accurate since the error of the sample lag time was of the same order of magnitude as the bed lag time. In this case, a lag time was calculated from the bubble velocity and the height of the bed.

In analyzing the pulse itself, it was necessary to obtain the height of the pulse at accurate increments of time. By scribing a clear plastic sheet with parallel lines every 2.5 mm, a template was made. Since the chart speed was 10 mm./sec., the altitude of the pulse could be read at multiples of 0.25 seconds. By placing the template over the chart paper and reading the pulse height at the intersection of the curve and the scribed lines with a magnifying glass, the altitude could be read to within 0.3 mm. The accuracy of the time measurement was estimated to be within 0.01 seconds.

VI. EXPERIMENTAL RESULTS

Frequency response tests were first made in the packed bed at two air flow rates. The tests conducted using helium demonstrated that in the region of frequencies studied, the packed bed behaved like a plug flow reactor. The amplitude ratio remained at the value of one, up to the limit of reliability of the pulse testing technique used. This upper limit of reliability depended on the width of the input pulse used. To decrease the width of the pulse, the injection point was placed as close as possible to the calming section. The volume of the calming section was the smallest that could be made and still provide good distribution of flows. In addition, the calming section was divided into six smaller volumes with baffles to eliminate gross circulation patterns which could be present. With these precautions, the input pulse could still be described by a sharp increase in concentration followed by an exponential decay. The decay was always slow enough so the width of the input pulse was reasonably long.

Figures 9, 10, 11 and 12 illustrate the input and response curves for the packed bed and fluidized bed with helium and "Freon-12" as tracer gases. Appendix VI presents the data read from the curves in the form

FIGURE 9

SAMPLE PACKED BED HELIUM TRACER CURVE

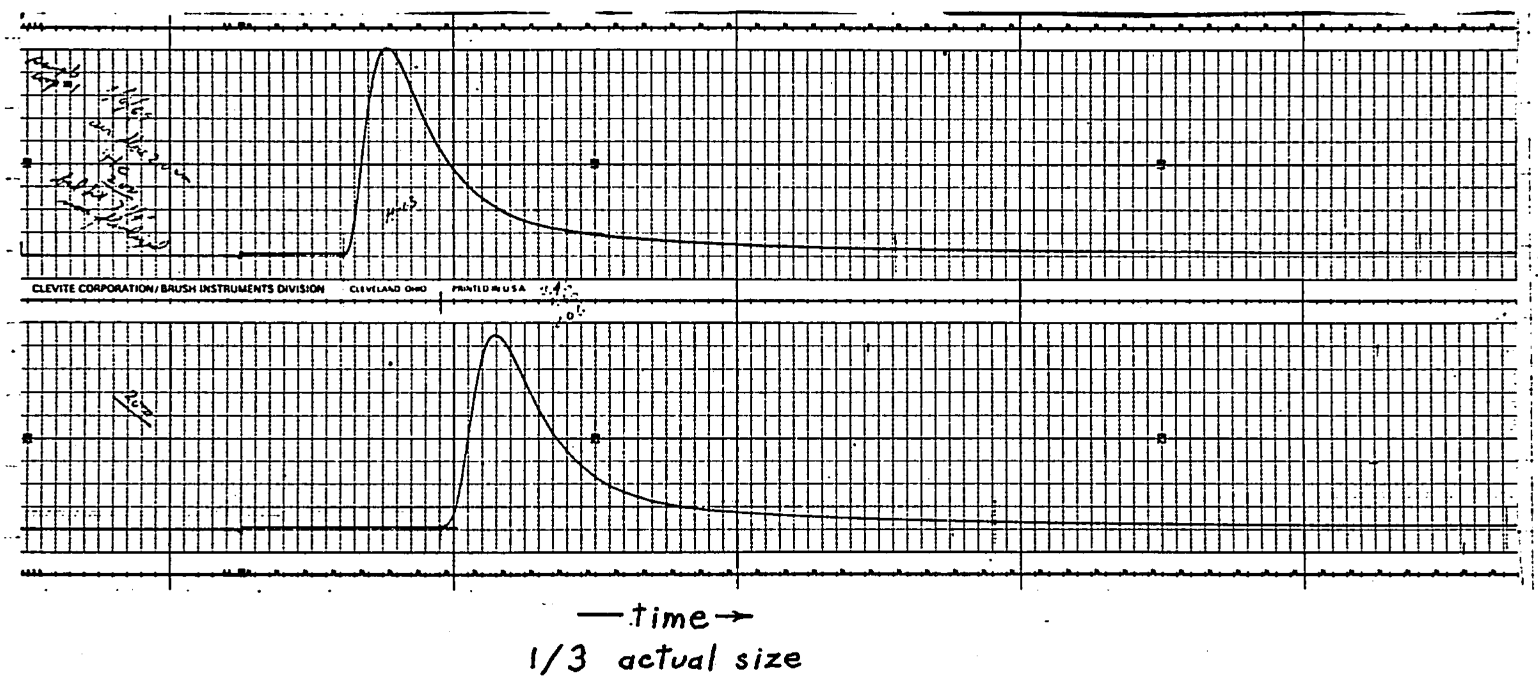


FIGURE 10 SAMPLE PACKED BED "FREON-12" TRACER CURVE.

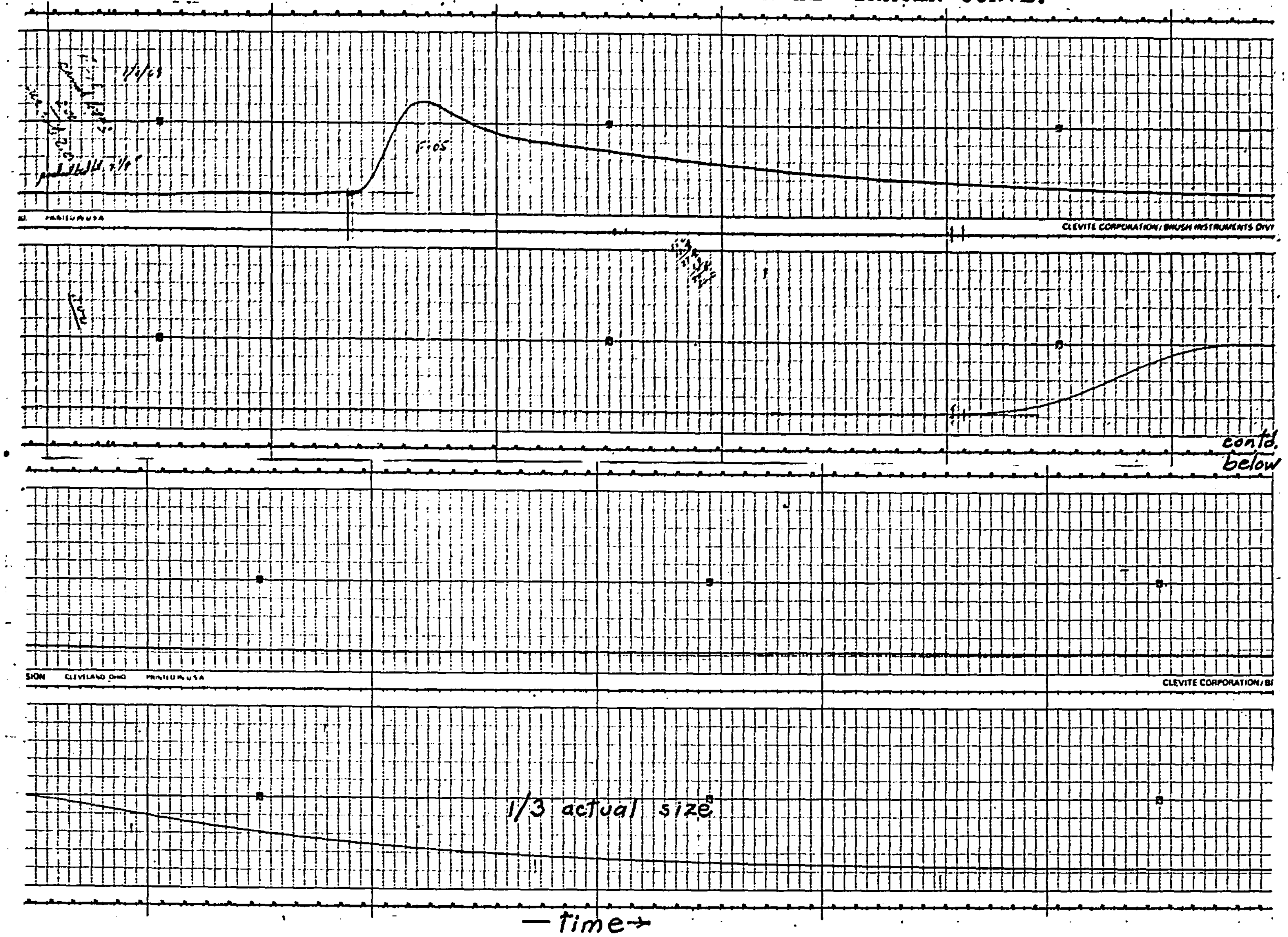
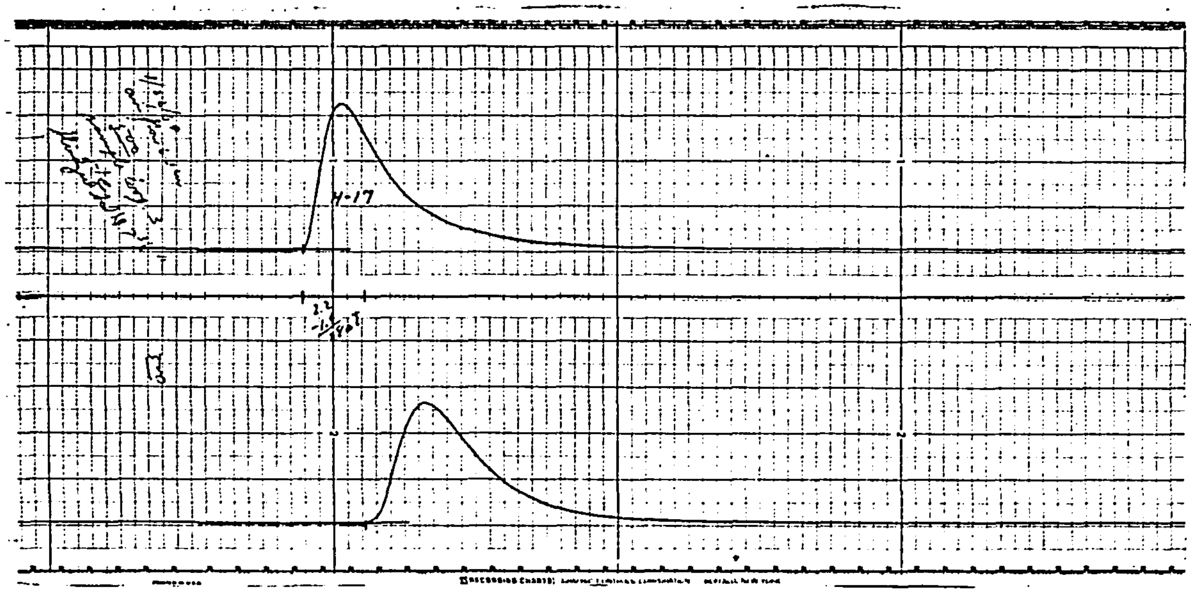


FIGURE 11

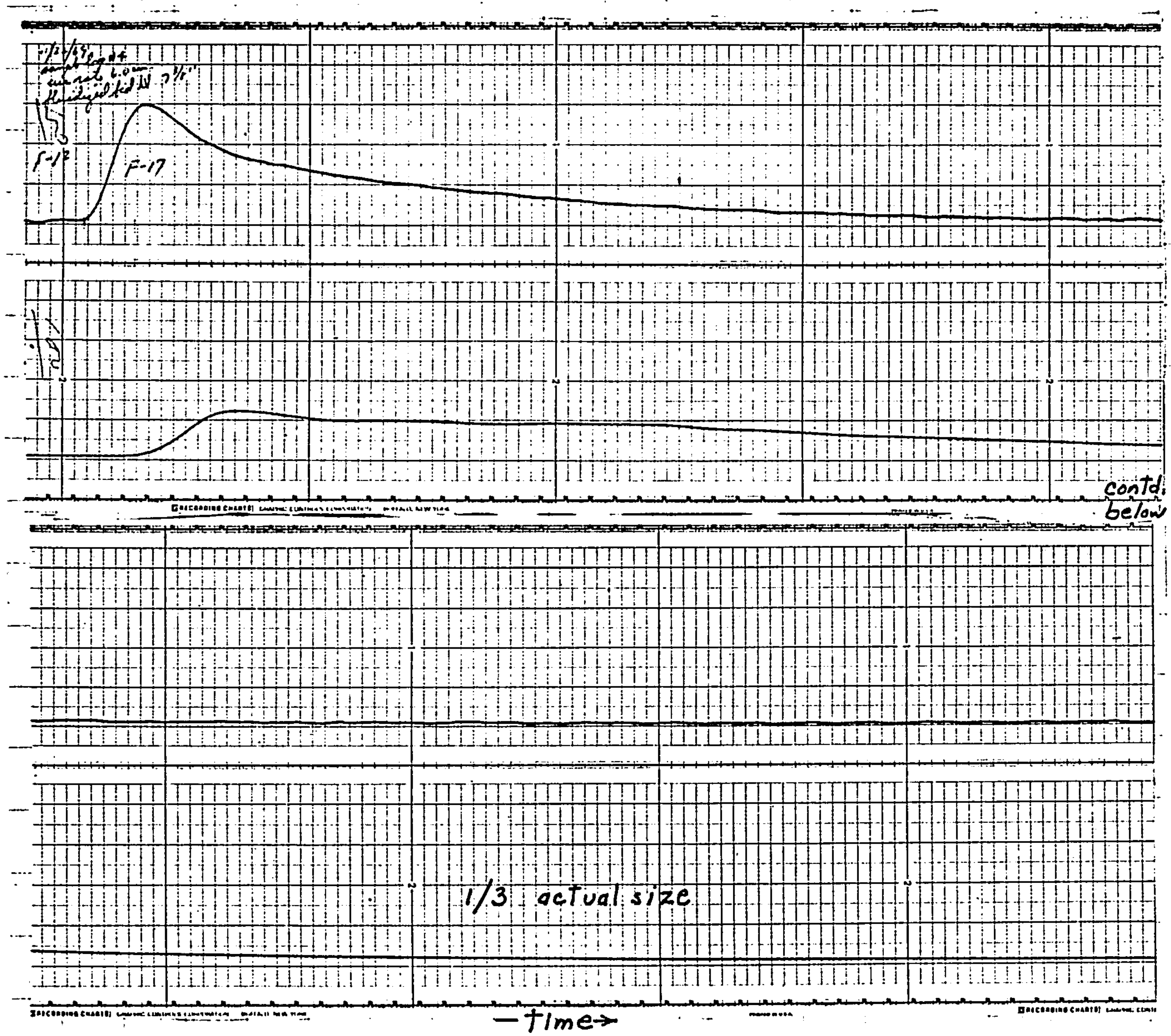
SAMPLE FLUIDIZED BED HELIUM TRACER CURVE



—time→

1/3 actual size

FIGURE 12 SAMPLE FLUIDIZED BED "FREON-12" TRACER CURVE



of the computer input for DPLS. DPLS was the name given to the computer program which converted the input and output histories of the bed into the transfer function of the bed. The actual measured lag time between pulses is tabulated separately (Table XXXVIII) to complete the raw data section. The transfer function is presented in the form of magnitude ratios and phase angle vs. frequency in a Bode plot. These calculated data are presented in Appendix V as computer printouts. The correction for lag time was done by the computer program for the packed bed cases. Calculated dead times were used for the fluidized bed cases. The corrections to the phase angle are shown in Table III in Appendix IV.

The experimental lag times for the fluidized bed were determined to be unreliable so lag times were calculated using theoretical bubble velocities. The final results then became consistent.

The experimental transfer functions are shown in Figures 13, 14, 15, 16 and 17. At the frequencies of interest when adsorption was occurring, the packed bed was operating in a plug flow condition. This was determined from the helium test. The magnitude ratio remained at the value of 1.0 and the phase angle obeyed the equation $\phi = -wL$.

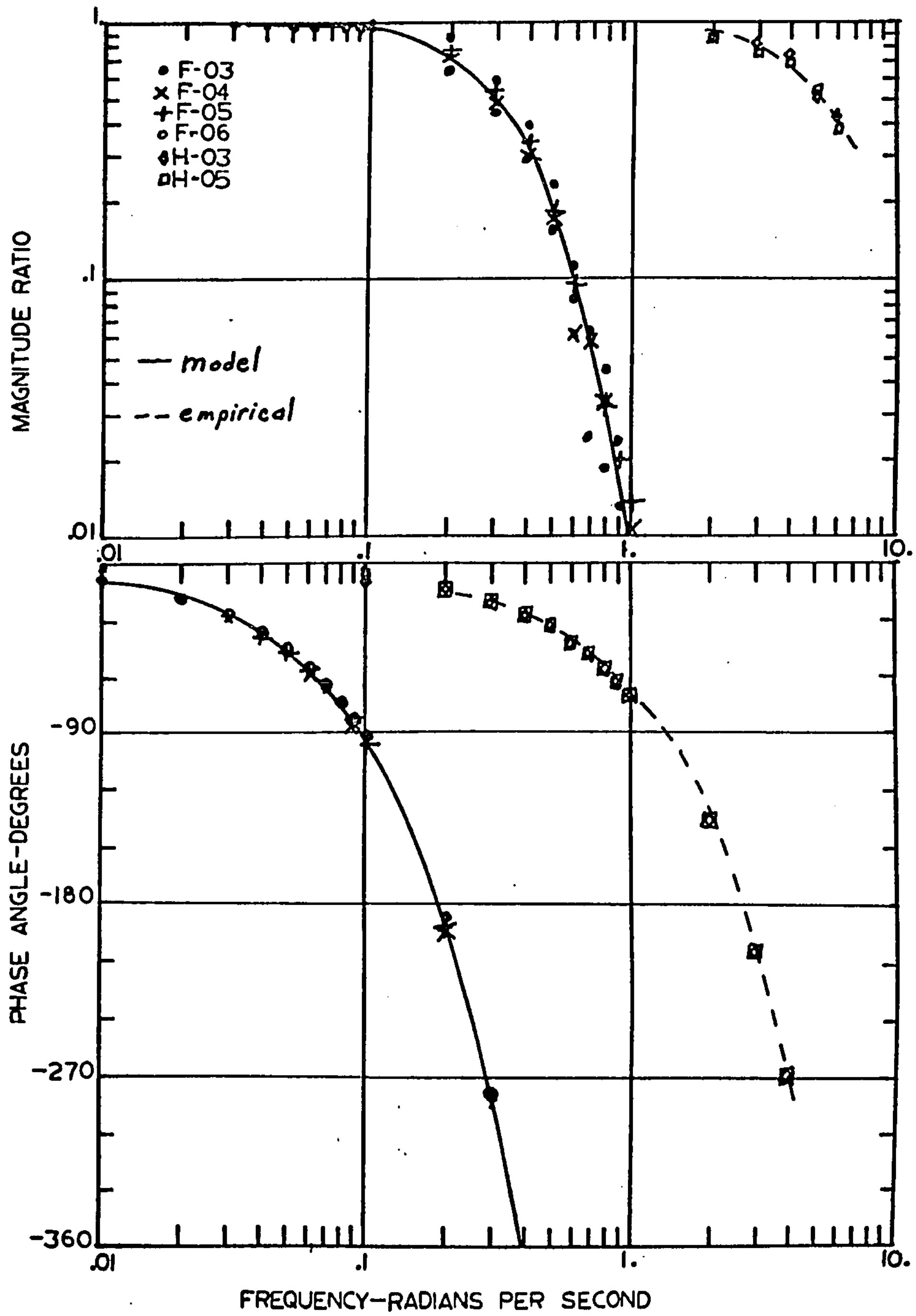


FIGURE 13 U=.1175 FT./SEC. 7-1/4 IN. PACKED BED

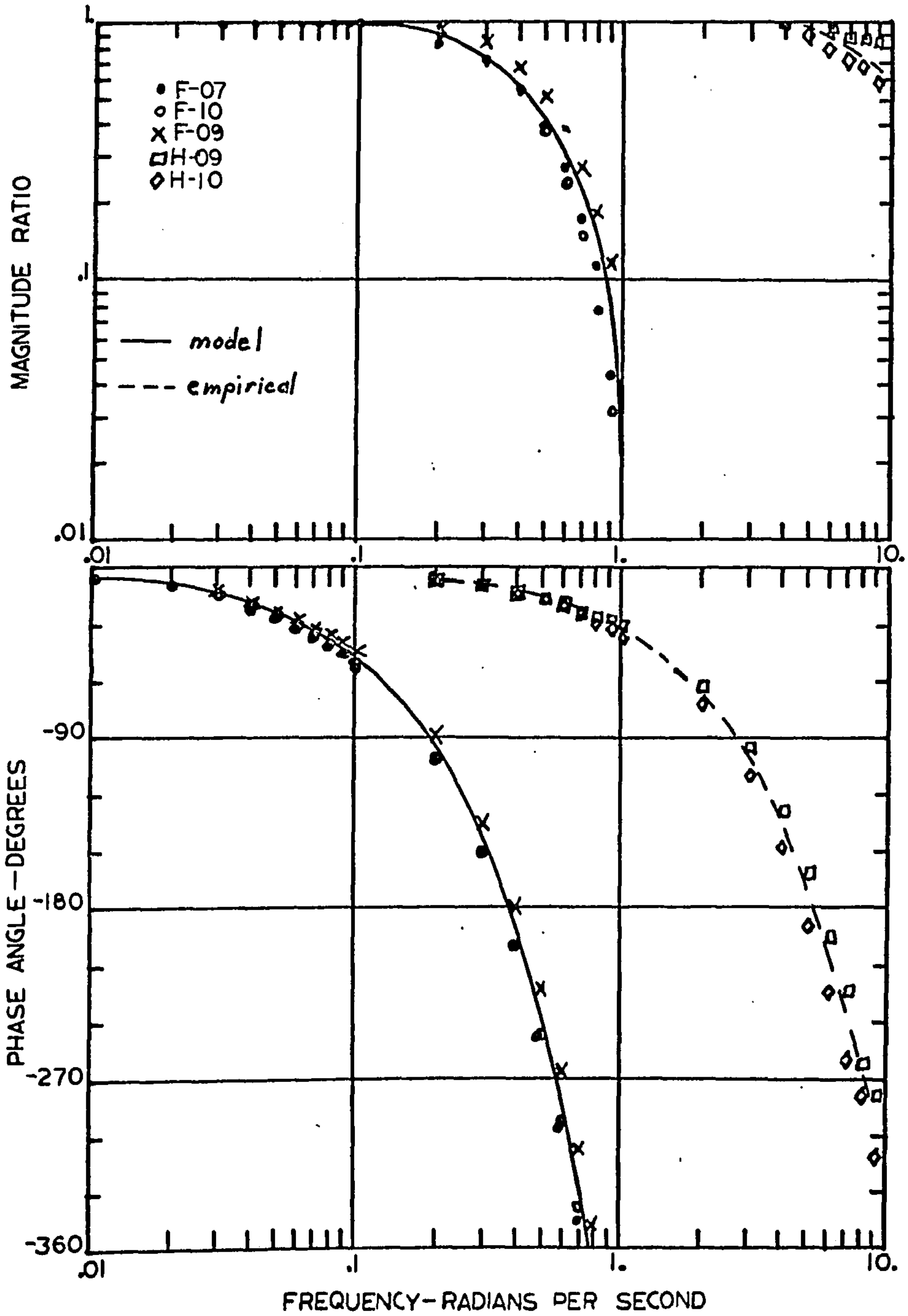


FIGURE 14 U=.219 FT./SEC. 7-1/4 IN. PACKED BED

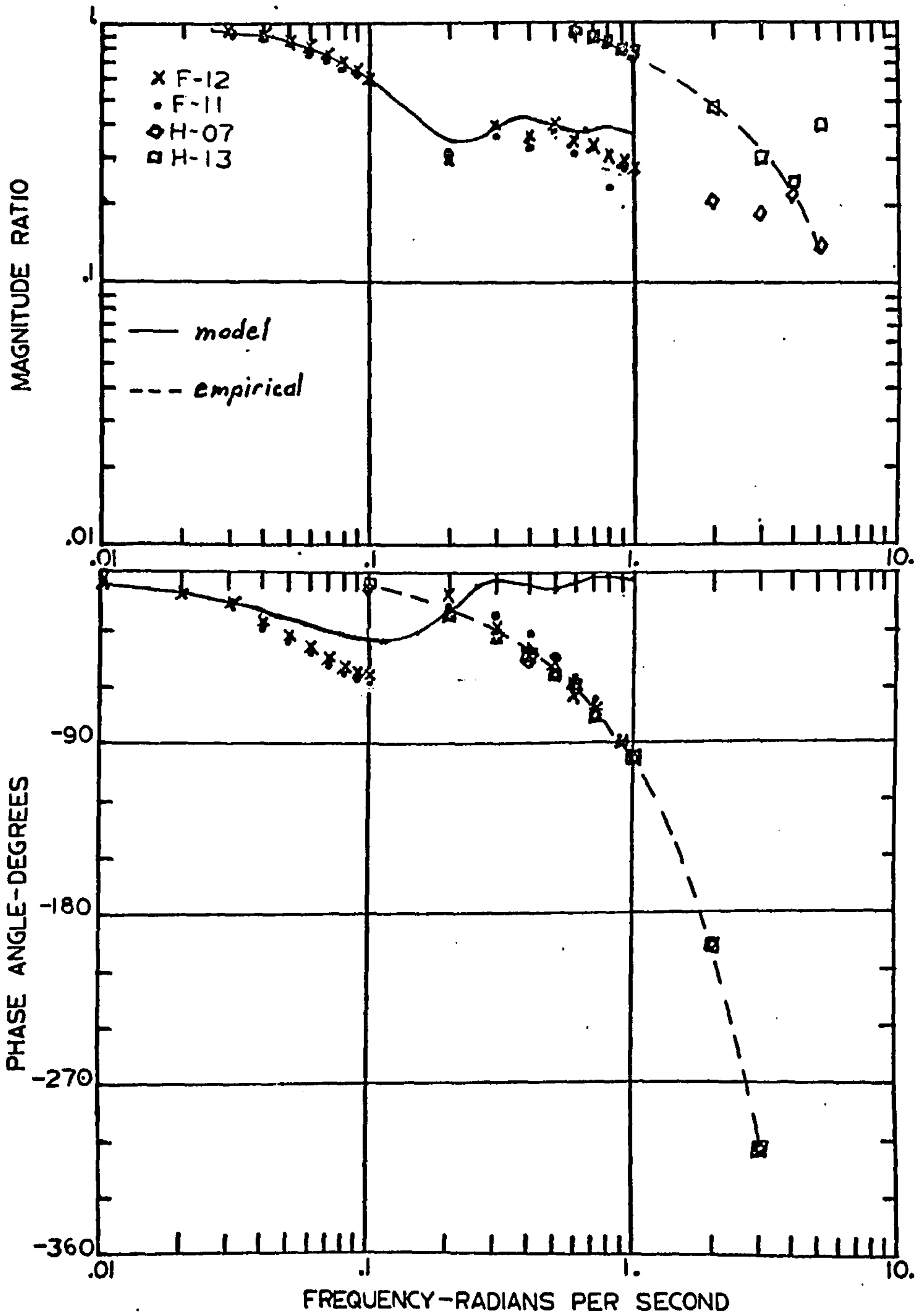


FIGURE 15 U=.264 FT./SEC. 7-1/4 IN. FLUIDIZED BED

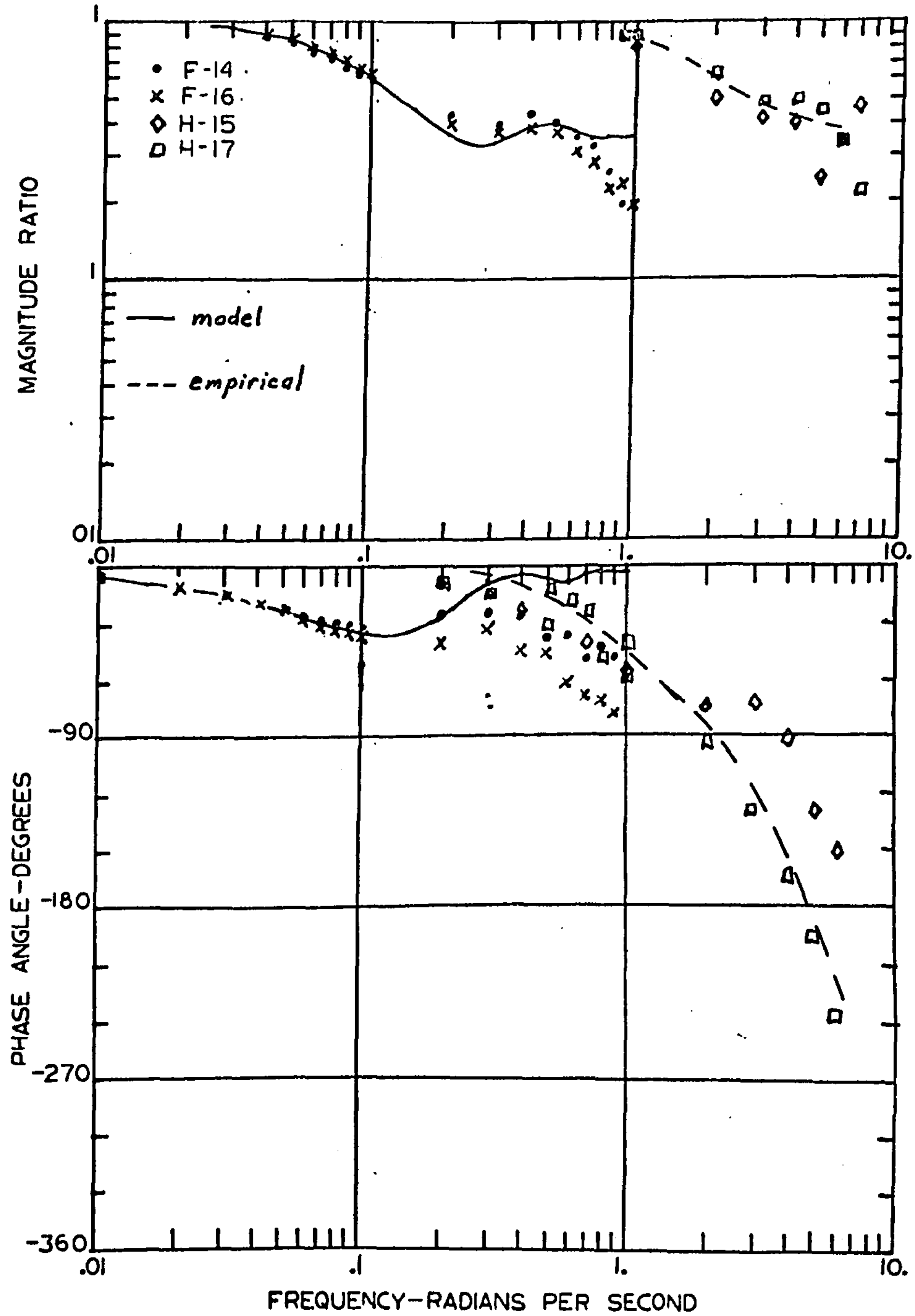


FIGURE 16 U=.309 FT./SEC. 7-3/8 IN. FLUIDIZED BED

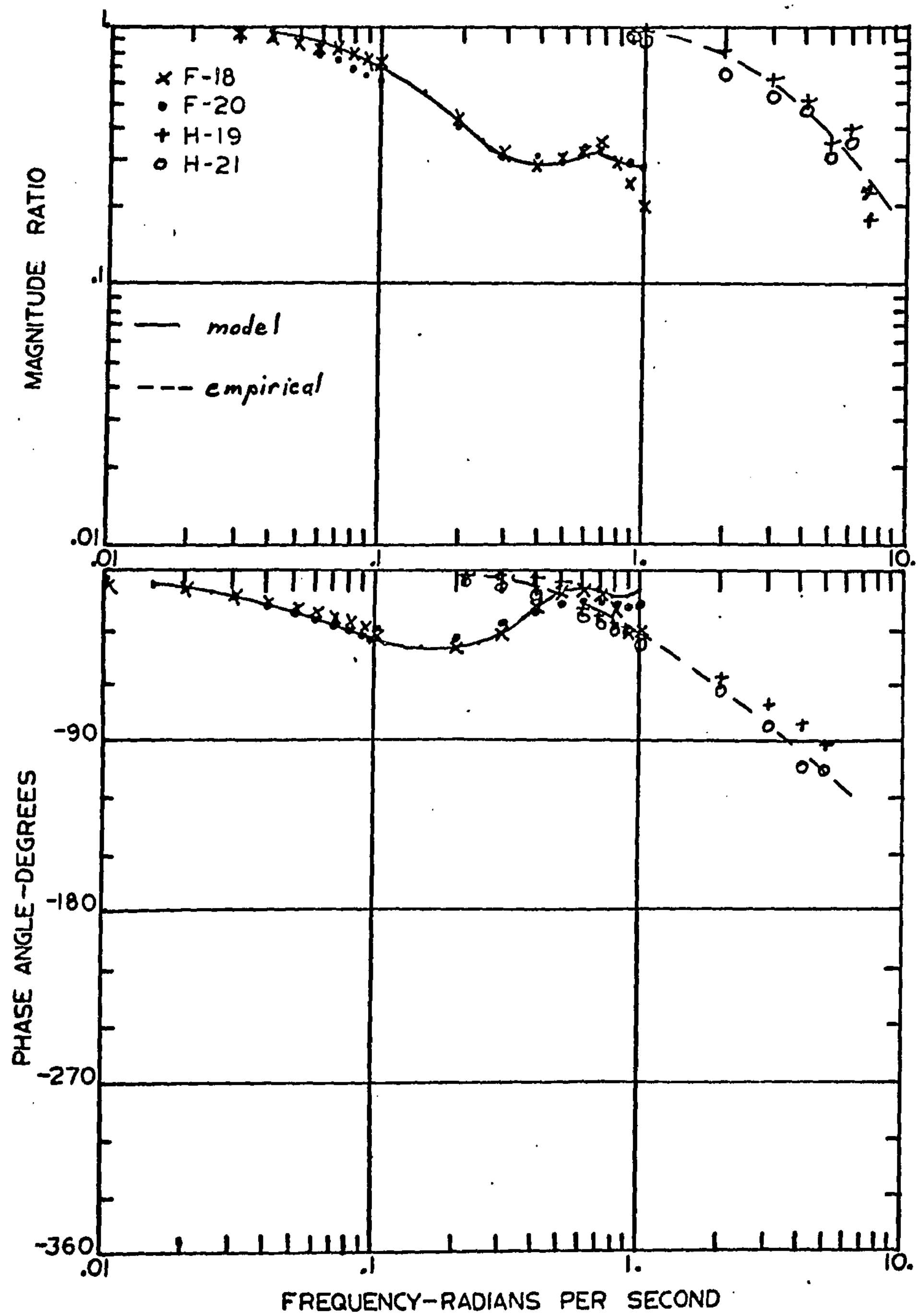


FIGURE 17 U=.399 FT./SEC. 7-5/8 IN. FLUIDIZED BED

This is exactly the response expected for a plug flow mixing pattern. Looking at the curves, then, the adsorption studies in the packed bed region were in a plug flow region and the plug flow model applies.

After establishing that the packed bed was operating in a plug flow manner for the frequencies studied, the "Freon-12" tracer was introduced to determine the dynamics of adsorption. Adsorption was fairly strong. The packed bed was tested at two different flow rates. The results are presented in two Bode plots in Figures 13 and 14.

The frequency response model of the packed bed using adsorption which was described by a first order reversible reaction was fitted to the data. Agreement was good indicating the above assumption was suitable. The other mechanisms tried were adsorption with pore diffusion, adsorption with a film coefficient, and adsorption with film coefficient and pore diffusion. These models did not give as good an overall fit as the simple adsorption model. This does not mean that these models are not applicable but just that for the conditions used in the experiments, they did not play a dominant role.

The adsorption parameters were determined by using the computer program NLIN1, a nonlinear least squares program modified from NLIN,[12] a previously published program. The results for one case are shown in Appendix V. The program is listed in Appendix III. The values of k_1 and k_2 were found to be 46.5 and 4.25 respectively in consistent units. Similar results were found for the two flow rates used in the packed bed, indicating that there was little or no effect of flow on these parameters. These experimental values were satisfactory to use in the fluidized bed regions. In the plug flow model one necessary parameter needed was the void volume. Published data[20] for the Alcoa F-1 catalyst was used. The external void volume fraction used was 0.468. This value was used because facilities weren't available to measure external void volume. To check this value, however, the sum of the external and internal void volume fractions was determined using water. This experimental total void fraction was found to be 0.693. Since this value compared favorably with the published data (0.73), the external void fraction was deemed to be correct for the alumina used during these experiments.

The experimental results in the fluidized bed were consistent and the response was linear within the limits of the concentration ranges studied. The test for linearity of the system was done by changing the amount of tracer injected. This did not change the shape or the width of the curves but increased the relative concentration of tracer. As mentioned in the Theory chapter, if this change did not affect the frequency response curves, the system behaved in a linear fashion. This was found to be the case. The frequency response curves with the "Freon-12" tracer occurred at nearly a decade of frequencies lower than the helium tracer curves.

The curves showed the expected "blip" in the magnitude ratios and phase angles which are characteristic of distributed parameter systems. The explanation for this type of response occurs when the flow of gas in the bed is through at least two types of mixing regions. Each region has its characteristic frequency response plot. At the exit of the bed when the flows through these regions combined, there is a counteraction because of the relative phase shift.

Remembering the consistency of frequency response testing via the pulse method and direct sinusoidal forcing, it is easier to picture what occurs with direct sinusoidal forcing. When two curves of the same frequency are combined that are shifted by 180° or multiples of 360° plus 180°, the curves combine to give a minimum in the magnitude. Conversely, when the curves are shifted by multiples of 360°, reinforcement occurs giving a maximum for the magnitudes.

The limits of reliability of frequency response data have long been established by a previous investigator.[3] The normalized frequency content of the input pulse was used for a reliability criterion. Clements and Schnelle[3] reported the maximum frequency to which reliable frequency response data can be obtained. This is when the normalized frequency content of the input pulse falls below 0.2. With the helium tracer tests, this critical frequency was between 1.0 and 2.0 radians per second. With the "Freon-12" tracer, this critical frequency was around 0.5 radians per second.

With this criterion, the range and the upper limit of reliable data was determined by both the shape and the width of the input pulse. If a normalized frequency distribution curve is plotted with normalized frequency content as ordinate, and normalized frequency (frequency x pulse width) as abscissa, the shape of the curve depends on the shape of the pulse. The shape of the curve determines the normalized frequency where the normalized frequency content is 0.2.

Since the shape of the curve could not be changed easily with the apparatus used, the maximum frequency for reliability was obtained by minimizing the pulse width.

VII. DISCUSSION OF EXPERIMENTAL RESULTS

The comparisons of experimental and theoretical curves when adsorption occurs in the fluidized bed, are in Figures 15, 16 and 17 for the three flow rates studied. The parameters for the proposed model were determined for the cases where adsorption occurred. With helium for the tracer gas, the same model was applied. These results, however, were inconclusive because there was not enough data before the critical frequency for reliability of the curves. However, some general statements could be made for the helium tracer results. Applying a general empirical transfer function composed of a first-order response and a distance-velocity time delay, the frequency response curve for the magnitude ratio could be described by a first-order response and the phase angle curve by a steadily decreasing curve as frequency increased.

With this in mind, the following generalizations could be drawn from the helium tracer results:

1. As flow rate increased, the residence time of the bed decreased.

2. As flow rate increased, the dead time decreased.

The following generalizations could be drawn from the "Freon-12" tracer results:

1. As flow rate increased, the minimum of the node occurred at higher frequencies.
2. For all flow rates, the magnitude ratio curves were essentially the same shape except for location of the nodes.

Comparing the results with the helium and "Freon-12" tracers, the frequency response curves with the "Freon-12" tracers were located over a decade of frequencies lower than the response curves using helium tracer.

Each adjustable model parameter appeared to affect a distinct portion of the frequency response curves. This relationship proved helpful in determining the model parameters, although some interaction did exist.

The plug flow volume fraction, V_p, affected the shape of the curve by controlling the major shape of the curve. At high values of V_p the response was similar to the plug flow reactor, that is, there was a sharp decrease in magnitude ratio and phase angle as the frequency increased. At low values, the response was similar to a completely mixed reactor since decreases in V_p caused a corresponding increase in the completely mixed volume fraction, V_b. The value of V_p also affected, within limits, the value of the minimum of the node in the magnitude ratio.

The volume of bed in bypass flow, V_{by}, affected the overall values of the magnitude ratio and phase angle. As V_{by} increased, the values of the magnitude ratio increased, especially the values around the node. As V_{by} increased, the overall values of the phase lag decreased. This was understandable since the velocity of the bypassing gas was high in relation to the velocities in the other flow regions.

The value of the interchange coefficient, k, affected the difference in height between the minimum and maximum of the node. As k increased, the difference decreased. In the limit as k increased, the overall response would take on the character of the region which had the highest volumetric flow rate.

The value of the efficiency of the plug flow region, E_p, determined the frequency where the minimum of the node was located. As E_p decreased, the minimum would be shifted to the higher frequencies.

The model with adsorption did fit the experimental results well to the limit of reliability of the data. The parameters of the model with adsorption are tabulated in Table II. The parameters V_b, V_p, V_{by}, V_d, k, E_p and E_b were determined by trial and error. The use of the computer program NLIN1 using the fluidized bed model was tried unsuccessfully in an effort to obtain the values of the parameters. The program had a tendency to minimize the least squares of the deviation using unrealistic values of the parameters. The locations of the minima and maxima were felt to be more important than the closeness of fit in the determination of the applicability of the model.

The use of the model with one stage was adequate to describe the response of the fluidized bed. Since the bed was short, this result was not unreasonable.

The theoretical values of the transfer functions are shown in Appendix V. The theoretical model could only be used to evaluate the parameters for the fluidized with adsorption. The limit of reliability of the data for the fluidized bed without adsorption did not allow enough of the frequency response curve to be fitted with the model to any reasonable degree of accuracy. Further discussion will be concerned with the use of the model with adsorption.

TABLE II

ONE STAGE MODEL PARAMETERS

Flow Rate SCFM	u ft./sec.	Height ft.	Lag Time sec.	V_b	V_p	V_d	V_{by}	k
1.36	0.1175	0.599	26.1	---	1.0	-----	-----	----
2.54	0.219	0.599	12.2	---	1.0	-----	-----	----
3.06	0.264	0.604	0.5	.348	0.319	0.281	0.052	0.22
3.58	0.309	0.620	0.275	.448	0.349	0.151	0.052	0.22
4.62	0.399	0.646	0.286	.580	0.37	0.	0.05	0.22

Flow Rate SCFM	γ_b	γ_p	E_p	E_b	k_1	k_2	u_b
1.36	-----	0.542	1.0	---	46.8	4.25	-----
2.54	-----	0.542	1.0	---	46.9	4.24	-----
3.06	0.542	0.542	1.0	1.0	46.8	4.25	0.241
3.58	0.542	0.542	0.8	1.0	46.8	4.25	0.241
4.62	0.521	0.542	0.5	1.0	46.8	4.25	0.326

u_{mf} = 0.241 ft./sec.

z_{mf} = 0.599 ft.

Cross Sectional Area = 0.193 ft.^{2}

Referring again to Table II, it was noted that as flow rate increased, the fraction of the bed in backmix flow increased. At low flow rates, the rapid mixing occurs around the vicinity of the bubble, but as the flow rate increases, the mixing of the particles increases. It should be noted that with adsorptive gases in the system, the motion of the particles carrying adsorbed gas determines to a large degree what is happening in the fluidized bed.

At the two lower flow rates, an additional region was necessary to bring the theoretical response in line with the experimental results, a dead region.

The dead region was defined as the volume within the bed where little or no gas flow was present. This could be explained by an uneven flow of gases through the distributor at low flow rates. Instead of flowing through the bed in a uniform fashion, a portion of the bed would be inactive, in effect, creating a smaller fluidized bed within the confines of the total catalyst volume. This region of relative inactivity was noted during the experiments. The bubbles were observed near the center of the bed at low air flow rates. At the highest flow rate studied, the entire bed was active.

The dead volume fraction, V_d, and the plug flow volume fraction, V_p are physically in the same volume of the fluidized bed and should be studied together. As flow rate increased, the sum of the dead volume fraction and the plug flow volume fraction decreased. The dead volume fraction decreased and finally disappeared at the highest flow rate. As flow rate increases, the fluidized bed becomes more active. It is expected that as flow rate further increases, the plug flow volume fraction will almost disappear because of the growing volume fraction of the completely mixed region. Inefficiencies in contacting will primarily be through bypassing gas via the bubbles. Thus, as flow rate continues to increase, the fluidized bed response would be similar to a completely mixed system with bypassing.

The dead volume, V_d, was introduced so the bypass volume could be increased at lower flow rates and maintain the proper material balance. At the low velocities, it was evident that a considerable amount of bypassing was occurring. Based on the usual equations for bubble volume in fluidized beds and with bypassing occurring through the bubble, the introduction of dead volume allowed the increase of theoretical bubble volume fraction.

Since the bed was short, bypassing of gas would occur. This bypassing of gas was assumed to occur in the bubble phase since the bubble velocities were higher than in the remainder of the bed. Also the void within the bubble would be the logical place for gas bypassing without contact with the alumina particles. The introduction of bypassing in the model gave results which were good at the highest flow rate studied.

The bypass volume remained essentially constant as flow rates increased. The bubbles formed with the orifice type distributor were expected to be large. This type of distributor was chosen because it was of the type used industrially. By redesigning the distributor to produce smaller bubbles, it is expected that the volume of the bed in which bypassing gas is flowing should decrease. At higher aspect ratios, less gas should also bypass the bed.

It was found that the interchange coefficient, k, remained constant as flow rate increased. Again particle motion with adsorption determines to a large degree the value of this parameter.

Studying the interchange expression in equation (34), describing interchange between the plug flow and backmix region, can demonstrate this. In the expression

$$k\left[C_{b_n}(t) - C_{p_n}(t,z)\right] \tag{63}$$

k can be factored as follows:

$$k = k' + K M \tag{64}$$

where k' is the mass transfer coefficient, K is an adsorption coefficient and M can describe the volume of particles moving between the plug flow and backmix regions. If the adsorption coefficient is high, then the interchange of material between the two regions is controlled by particle movement It is conceivable that in the narrow range of flow rates used the particle motion between the plug flow and backmix regions would remain constant.

As flow rate increased, the efficiency of adsorption decreased in the plug flow region. The particle movement was determined to be a cause of this. The gas flowing through the plug flow region may be flowing in a plug flow fashion but the particles which adsorb the gas are in motion. This motion is not intense, but it does decrease the efficiency of adsorption. In a packed bed, the gas desorbed from a particle travels and is adsorbed by the particle above. This occurs for the length of the packed bed. When the particles are moving, this adsorption to the particle above the desorbing particle may not occur because previously adsorbed material may already be on the particle. This phenomena must necessarily decrease the efficiency of adsorption in the plug flow region.

Because of particle interaction, it is doubted that the model proposed can be used by omitting the adsorptive terms to describe the response of a fluidized bed where no adsorption is taking place.

VIII. CONCLUSIONS

The following conclusions can be drawn from this study:

1. The dynamics of adsorption in a fluidized bed can be described well using a unique approach to the use of a two-region model with bypassing. The completely mixed region describes the flow of gases and adsorbed gases around the vicinity of the bubble. The plug flow region describes the flow of gases and adsorbed gases through the remainder of the bed where particles are present. Bypassing occurs because of poor mixing in the bubble void volume.
2. The study in the transition region between packed beds and completely fluidized beds has shown that there is a logical transition in mixing patterns between these extremes. The adsorption dynamics can now be adequately described by a mathematical model. The parameters of the model also exhibit the proper behavior as flow rate increases.
3. This model, if necessary, can easily be adapted to more complicated situations where film coefficients and pore diffusion are dominant in the mechanism of adsorption.

4. The results demonstrate that there are three distinct flow patterns which exist in the partially fluidized bed. Also, at flow rates near minimum fluidization velocity, gas flow can create dead regions where there is no flow of gas or mixing of solids.
5. Adsorption data can be determined in the packed bed region and can be applied in the fluidized bed.
6. Particle movement was found to control the dynamics of adsorption in a fluidized bed.

IX. RECOMMENDATIONS

This study has shown that a mathematical model can be used to describe the dynamics of adsorption in fluidized beds at low fluidization velocities. It was felt in reading of the results of other researchers that since the packed bed was described using a plug flow model and the completely fluidized bed using a backmix model, there must be a reasonable transition from one model to another.

This study has shown this to be so. However, more work has to be done in this area of fluidized beds:

1. Beds with higher aspect ratios should be studied to determine if a staged model adequately represents the dynamics of tall beds.
2. There appears to be a correlation between the parameters of the model and bubble size and velocity. Bubble size studies should be done in conjunction with dynamic studies. There are no data at present to perform any correlation. Studies have been made correlating bubble properties and the parameters of fluidized bed models but these models should be tested in the unsteady state if they are to be rigorously tested.

3. Studies should be made with gases and materials which give different adsorption rates to determine if particle motion controls the interchange of gases between the two major flow regions.
4. Different distributor designs should be used to vary the bubble size and flow distribution.
5. Efforts should also be made to decrease the width of the input pulses so reliable data at high frequencies can be found.
6. Tests with non-adsorbable tracer gases should be continued to get a better understanding of gas mixing patterns in fluidized beds. The flow model would probably be predominately plug flow through the dense phase with bypassing occurring through the bubble phase. In determining the overall response of the bed, the effect of the portion of the bed operation at minimum fluidization conditions should always be accounted for, no matter how small the flow may be. These regions always affect the dynamics of the bed and mathematical simplification should not be made until it is shown that the region of low flow does not contribute to the overall dynamics of

the bed. The frequency response of fluidized bed models would not necessarily show the presense of the nodes unless all flow regions are taken into account.

7. Additional equipment should be considered to ease the tedious reading of values from the input and output histories. The use of two analog to digital converters which record the concentration histories, should provide a tailor-made computer input for analysis. The use of a data smoothing routine would be necessary, but the amount of time saved could be used for a more complete analysis with a larger number of experiments.

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NOMENCLATURE

A_j	*Change in f(t) at the boundary between interval T_{j-1} and T_j
a_k	*k^{th} constant
B_j	*Change in d f(t)/dt at the boundary between interval T_{j-1} and T_j
B_p	*Fraction of total flow in the plug flow region
B_y	*Fraction of total flow in the bypass region
c	*Concentration of adsorbable gas
C_{bn}	*Concentration of tracer in the plug flow region in the n^{th} stage
C_{fb}	*Concentration of tracer entering backmix region
C_{fp}	*Concentration of tracer entering the plug flow region from the previous stage
C_j	*Change in d^2 $f(t)/dt^2$ at the boundary between interval T_{j-1} and T_j
C_{pn}	*Concentration of tracer in the plug flow region in the n^{th} stage
C(s)	*Laplace transform of the exit concentration
D_j	*Change in d^3 $f(t)/dt^3$ at the boundary between interval T_{j-1} and T_j
D_v	*Volume fraction of bed as dead volume
$\frac{d^k}{dt^k}$	*k^{th} derivative with respect to time
e	*Base of the natural logarithm
E_b	*Catalyst efficiency in the backmix region

E_{mf}	*Porosity at minimum fluidization velocity
E_p	*Catalyst efficiency in the plug flow region
$F(iw)$	*Fourier transform of f(t)
$F(s)$	*Laplace transform of f(t)
$f(t)$	*A function of time expressed as a deviation from an initial condition
G_d	*Dead time element
$H(s)$	*exp $-(L_p s + N)$
i	* $\sqrt{-1}$
$I(w)$	*Imaginary part of F(iw)
j	*Index
k	*Interphase transfer coefficient
k'	*Mass transfer coefficient
k_1	*Adsorption rate constant
k_2	*Desorption rate constant
L	*Delay time, dead time, seconds
L_p	*Z/u_p
L_v	*Bypass time, seconds
m	*Total number of stages
M	*Volume of particles interchanging per unit time
M.R.	*Magnitude ratio
N	*$kZ/V_p u_p$
n	*Last value of index j
Q	*Moles tracer adsorbed per volume of catalyst
Q_b	*Moles tracer adsorbed per volume of catalyst

in the backmix region

Q_p	*Moles tracer adsorbed per volume of catalyst in the plug flow region
$R(w)$	*Real part of $F(iw)$
s	*Laplace operator
$\dot{\mathcal{s}}$	*$(1-\gamma_p)s + E_p\gamma_p Y_p(s)$
S	*Cross sectional area
t	*Time, seconds
t'	*Time, seconds
T.F.	*Transfer function
T_j	*Time at the j^{th} interval
T_p	*V_p/k
T_{vb}	*$V_b Z/u$
T_{vp}	*$V_p Z/u$
T_x	*Duration time of input pulse, seconds
T_y	*Duration time of output pulse, seconds
u	*Overall superficial velocity into the bed
u_b	*Superficial velocity through the backmix region
u_{by}	*Velocity through the bypass region
u_d	*Superficial velocity through the dense phase
u_{mf}	*Superficial gas velocity at minimum fluidization
u_p	*Superficial gas velocity through the plug flow region
u_v	*Velocity of the void volume as bubbles
$u(t-T_j)$	*Unit step function occurring at $t=T_j$

V_b	*Volume fraction of bed in backmix flow
V_{by}	*Volume fraction of bed bypassed
V_d	*Volume fraction of bed as dense phase
V_p	*Volume fraction of bed in plug flow
V_v	*Void volume fraction in the bed as bubbles
w	*Frequency, radians/second
X(s)	*Laplace transform of x(t)
x(t)	*Input variable as a function of time expressed as a deviation from an initial value
Y_b	*Complex adsorption admittance for the backmix region
Y_p	*Complex adsorption admittance for the plug flow region
Y'(s)	*Complex adsorption admittance
$y_p(t)$	*y(t) predicted
y(t)	*Output variable as a function of time expressed as a deviation from an initial value
Y(s)	*Laplace transform of y(t)
z	*Height in the stage
Z_m	*Height of the last stage
Z_{mf}	*Height of the bed at minimum fluidization velocity
Z_t	*Total height of the bed
z(t')	*Output variable as a function of time expressed as a deviation from an initial value

γ_b	*Volume fraction solids in the backmix region
γ_d	*Volume fraction solids in the dense phase
γ_ℓ	*Volume fraction solids in the lean phase
γ_{mf}	*Volume fraction solids at u_{mf}
γ_p	*Volume fraction solids in the plug flow region
γ_v	*Volume fraction solids in the dead zone
ϵ	*Porosity
ϵ_{mf}	*Porosity at u_{mf}
ϕ	*Phase Angle

APPENDIX I

ROTAMETER CALIBRATION CURVES

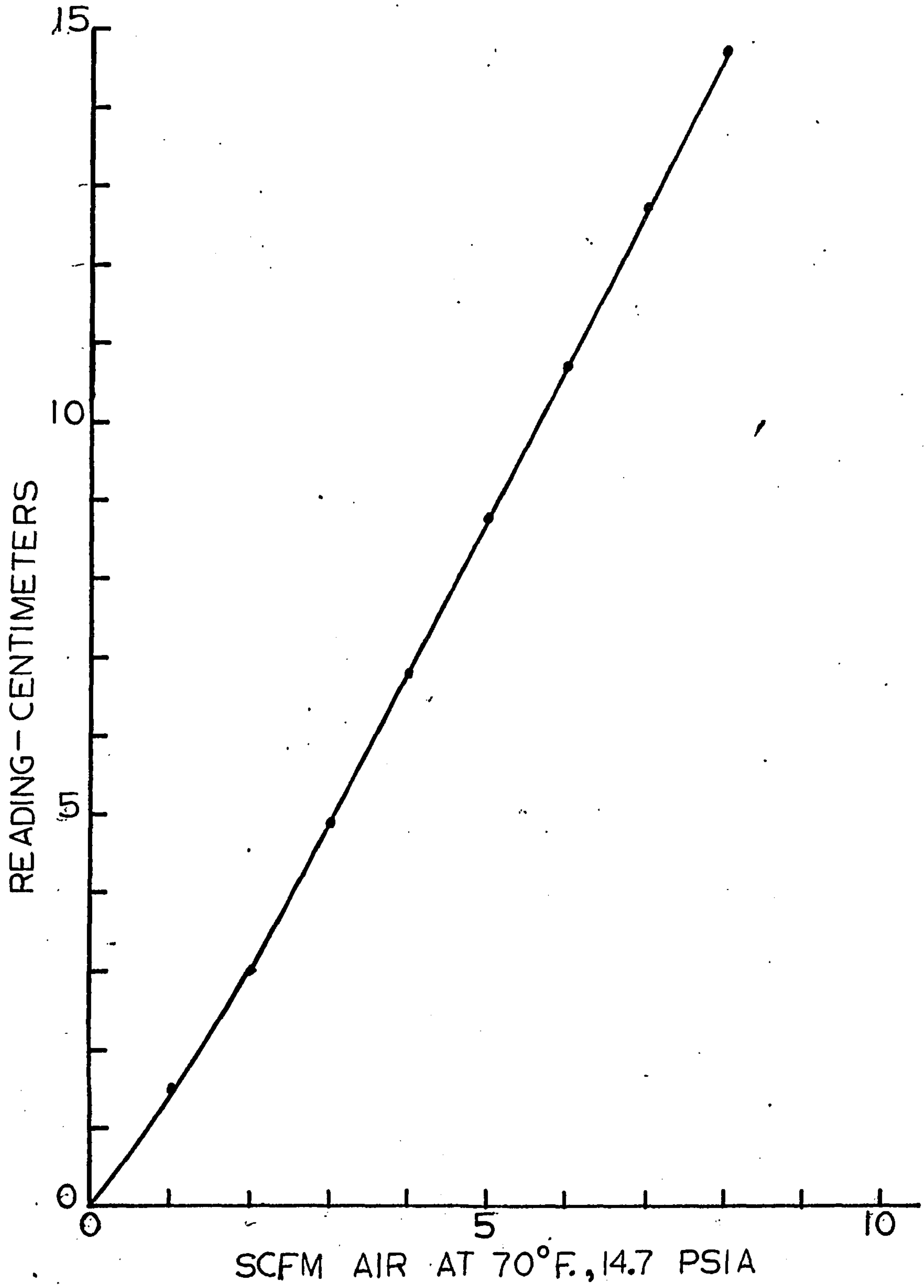

FIGURE 18 MAIN AIR FLOW CALIBRATION

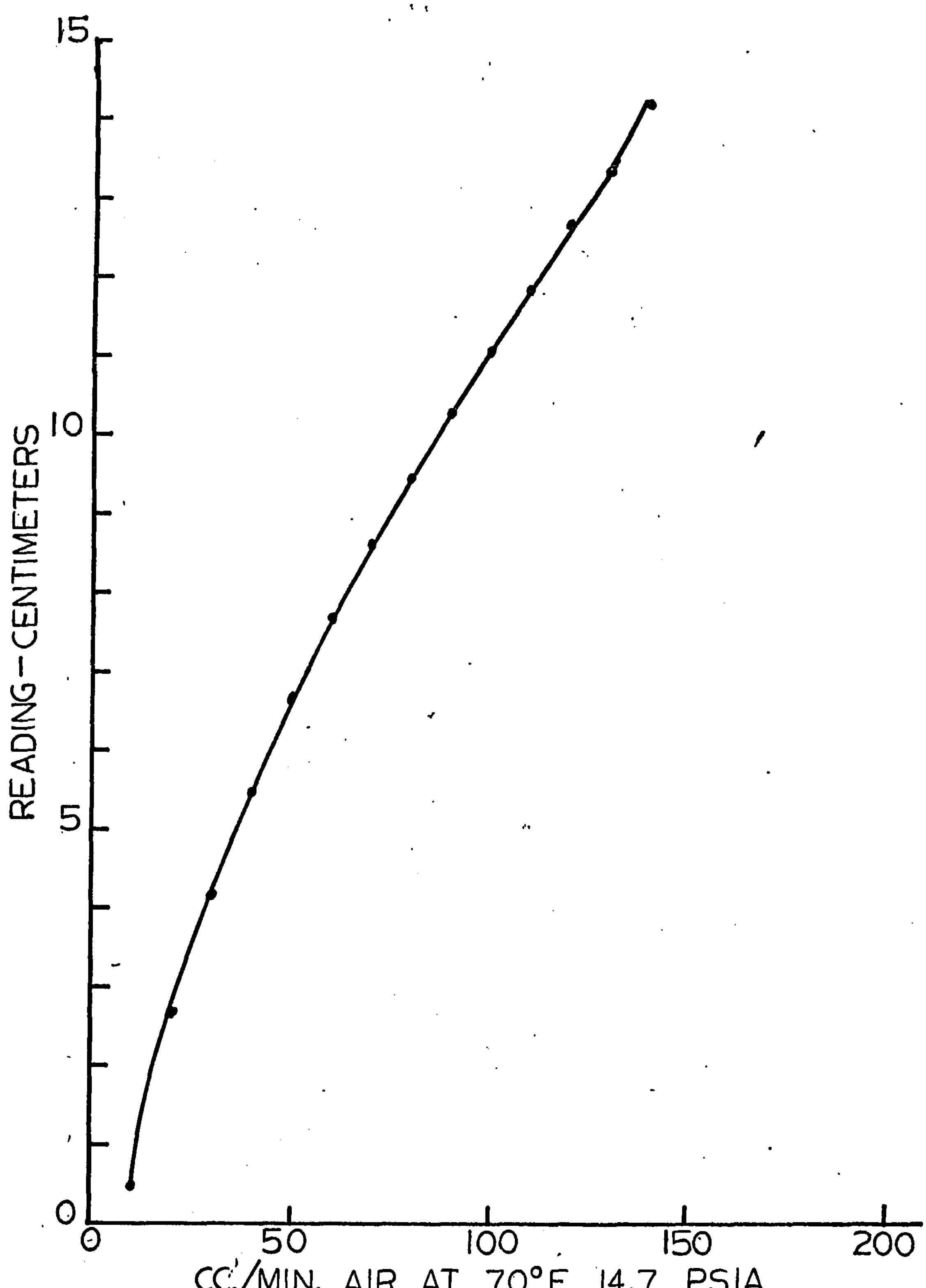

FIGURE 19
REFERENCE AND SAMPLE FLOWS

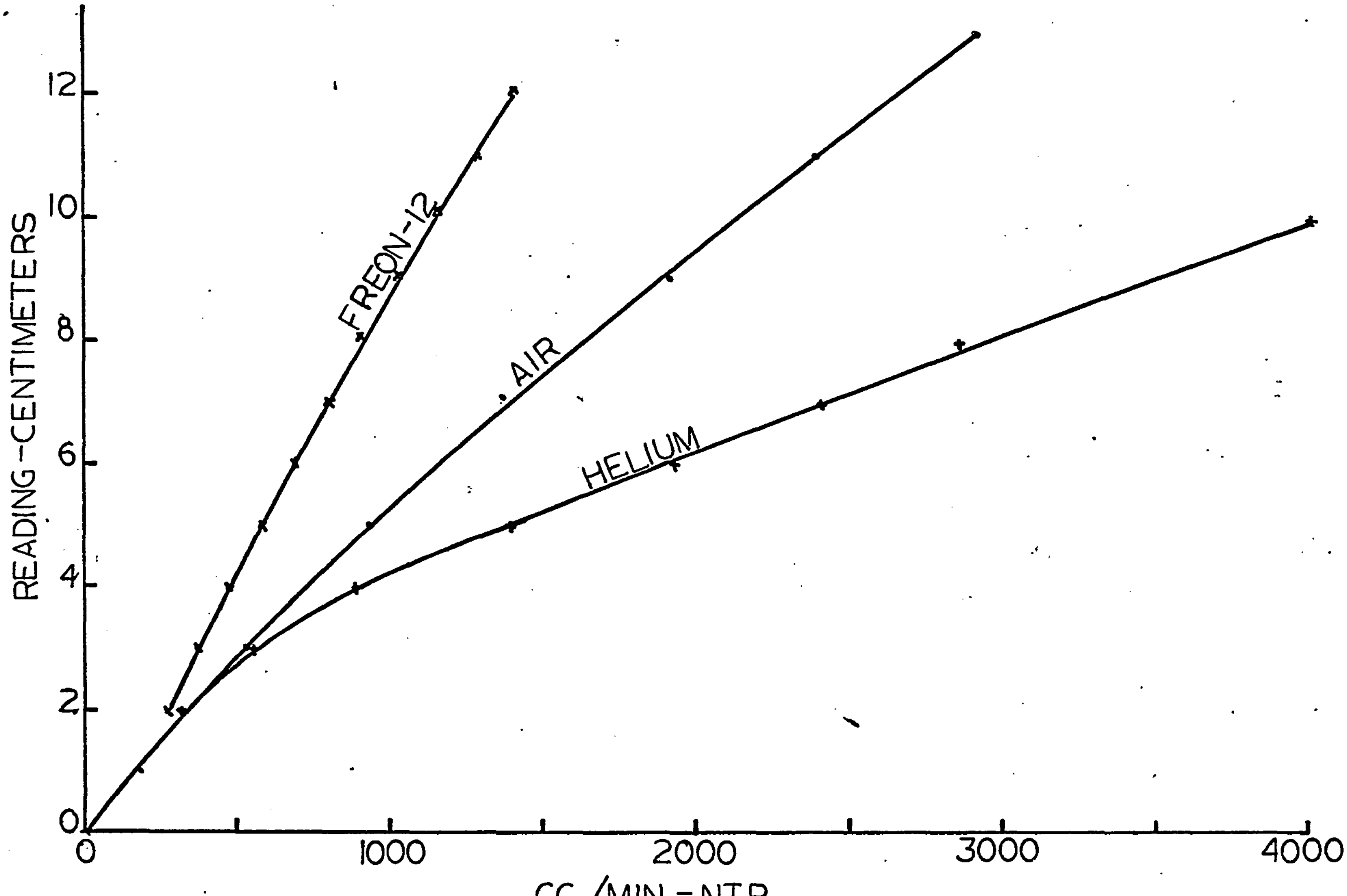

FIGURE 20 BLEED FLOW CALIBRATION

APPENDIX II

MATHEMATICAL DEVELOPMENT

MATHEMATICAL DEVELOPMENT OF MODEL

n^{th} Stage

Plug Flow Phase Material Balance

$$(1-\gamma_p) V_p \frac{\partial C_{pn}(t,z)}{\partial t} = k\left[C_{bn}(t) - C_{pn}(t,z)\right] - V_p \mu_p \frac{\partial C_{pn}(t,z)}{\partial z} - E_p \gamma_p V_p \frac{d q_p(t)}{dt} \tag{1}$$

Backmix Phase

$$(1-\gamma_b) V_b \frac{d C_{bn}(t)}{dt} = \frac{V_b \mu_b}{Z}\left[C_{fb}(t) - C_{bn}(t)\right] + \frac{1}{Z}\int_0^Z k\left[C_{pn}(t,z) - C_{bn}(t)\right] dz - E_b \gamma_b V_b \frac{d q_b(t)}{dt} \tag{2}$$

The exit concentration of the bed is given by

$$C(s) = \frac{V_b \mu_b}{\mu} C_{bm}(s) + \frac{V_p \mu_p}{\mu} C_{pm}(s, Z_m) + \frac{V_{by} \mu_{by}}{\mu} C_{by}(s) \tag{3}$$

where s is the Laplace transform variable and Z_m is the height of the last stage.

Define B_p as the fraction of total flow in the plug flow phase and B_y as the fraction of total flow bypassing the stage

$$\therefore\ C(s) = (1-B_p-B_y)\, C_{bn}(s) + B_p\, C_{pm}(s, Z_m) + B_y\, C_{by}(s) \tag{4}$$

Taking the Laplace transform of (1) where

$$C_{pn}(0, z) = C_{bn}(0) = q_p(0) = 0 \tag{5}$$

and

$$s\, q_p(s) = Y_p(s)\ C_{pn}(s, z) \tag{6}$$

where (6) will be derived later

$$(1-\gamma_p) V_p\, s\ C_{pn}(s,z) = k\left[C_{bn}(s) - C_{pn}(s,z)\right] - V_p \mu_p \frac{d\, C_{pn}(s,z)}{d z} - E_p \gamma_p V_p\, Y_p(s)\, C_{pn}(s,z) \tag{7}$$

Rearranging (7)

$$\frac{d\, C_{pn}(s,z)}{d z} + \alpha\ C_{pn}(s,z) = \frac{k}{V_p \mu_p}\ C_{bn}(s) \tag{8}$$

where

$$\alpha = \frac{(1-\gamma_p)\, s}{u_p} + \frac{E_p\ \gamma_p\, Y_p(s)}{u_p} + \frac{k}{V_p u_p} \tag{9}$$

Solving using operator notation for (8)

$$(D+\alpha)\, C_{pn}(s,z) = \frac{k}{V_p u_p}\ C_{bn}(s) \tag{10}$$

$$C_{pn}(s,z) = C_1\ \exp(-\alpha z) + \frac{k}{V_p u_p\, \alpha}\ C_{bn}(s) \tag{11}$$

Boundary Conditions

$$@\ z=0 \qquad C_{pn}(t,0) = C_{fp}(t)$$

$$C_{pn}(s,0) = C_{fp}(s)$$

$$\therefore\ C_1 = C_{fp}(s) - \frac{k}{V_p u_p\, \alpha}\ C_{bn}(s) \tag{12}$$

$$\therefore\ C_{pn}(s,z) = \left[C_{fp}(s) - \frac{k}{V_p u_p\, \alpha}\, C_{bn}(s)\right] \exp(-\alpha z) + \frac{k}{V_p u_p\, \alpha}\ C_{bn}(s) \tag{13}$$

Rearranging (13)

$$C_{pn}(s,z) = C_{fp}(s)\exp(-\alpha z) + \frac{k}{V_p u_p \alpha} C_{bn}(s)\left[1-\exp(-\alpha z)\right] \quad (14)$$

Now evaluate

$$\int_0^Z k\left[C_p(s,z) - C_b(s)\right] dz \qquad \text{from (2) using (14)}$$

$$k\int_0^Z \left\{C_{fp}(s)\exp(-\alpha z) + \frac{k}{V_p u_p \alpha} C_{bn}(s)\left[1-\exp(-\alpha z)\right] - C_{bn}(s)\right\} dz \quad (15)$$

$$= k\,C_{fp}(s)\int_0^Z \exp(-\alpha z)\,dz + \frac{k^2}{V_p u_p \alpha} C_{bn}(s)\int_0^Z dz - \frac{k^2}{V_p u_p \alpha} C_{bn}(s)\int_0^Z \exp(-\alpha z)\,dz - kC_{bn}(s)\int_0^Z dz \quad (16)$$

$$= k\,C_{fp}(s)\left.\frac{\exp(-\alpha z)}{-\alpha}\right|_0^Z + \frac{k^2}{V_p u_p \alpha} C_{bn}(s)\left. z\right|_0^Z + \frac{k^2 C_{bn}(s)}{V_p u_p \alpha}\left.\frac{\exp(-\alpha z)}{\alpha}\right|_0^Z - kC_{bn}(s)\left. z\right|_0^Z \quad (17)$$

$$= k\,C_{fp}(s)\frac{\exp(-\alpha z)}{-\alpha} + \frac{k\,C_{fp}(s)}{\alpha} + \frac{k^2 C_{bn}(s)}{V_p u_p \alpha} Z + \frac{k^2 C_{bn}(s)}{V_p u_p \alpha^2}\exp(-\alpha Z) - \frac{k^2 C_{bn}(s)}{V_p u_p \alpha^2} - k\,C_{bn}(s)\,Z \quad (18)$$

Rearranging (18)

$$k\int_0^Z [C_{pn}(s,\zeta) - C_{bn}(s)]\,d\zeta = \frac{k\,C_{fp}(s)}{\alpha}\left[1-\exp(-\alpha Z)\right] + \frac{k^2 C_{bn}(s)}{V_p \mu_p \alpha}\left[Z - \frac{1}{\alpha}(1-\exp(-\alpha Z))\right] - k C_{bn}(s)\, Z \qquad (19)$$

Taking the Laplace transform of (2) and applying conditions

$$C_{bn}(0) = q_b(0) = 0 \qquad ; \; s q_b(s) = Y_b(s)\, C_{bn}(s) \qquad (20)$$

$$V_b(1-\gamma_b)\, s\, C_{bn}(s) = \frac{V_b \mu_b}{Z}\left[C_{fb}(s) - C_{bn}(s)\right] + \frac{1}{Z}\int_0^Z k[C_{pn}(s,\zeta) - C_{bn}(s)]\,d\zeta - \gamma_b V_b E_b Y_b(s)\, C_{bn}(s) \qquad (21)$$

Substituting (19) into (21)

$$V_b(1-\gamma_b)\, s\, C_{bn}(s) = \frac{V_b \mu_b}{Z} C_{fb}(s) - \frac{V_b \mu_b}{Z} C_{bn}(s) + \frac{k\,C_{fp}(s)}{Z\alpha}\left[1-\exp(-\alpha Z)\right]$$

$$+ \frac{k^2 C_{bn}(s)}{V_p \mu_p \alpha Z}\left[Z - \frac{1}{\alpha}(1-\exp(-\alpha Z))\right] - \frac{k C_{bn}(s) Z}{Z} - \gamma_b V_b E_b Y_b(s)\, C_{bn}(s) \qquad (22)$$

Rearranging (22)

$$\left\{(1-\gamma_b) V_b s + \frac{V_b \mu_b}{Z} - \frac{k^2}{V_p \mu_p \alpha}\left[1-\frac{1}{Z\alpha}(1-\exp(-\alpha Z))\right] + k + \gamma_b V_b E_b Y_b(s)\right\} C_{b_n}(s)$$

$$= \frac{V_b \mu_b}{Z} C_{fb}(s) + \frac{k C_{fp}(s)}{Z\alpha}\left[1-\exp(-\alpha Z)\right] \tag{23}$$

Solving (23) for $C_{bn}(S)$

$$C_{b_n}(s) = \frac{\frac{V_b \mu_b}{Z} C_{fb}(s) + \frac{k C_{fp}(s)}{Z\alpha}\left[1-\exp(-\alpha Z)\right]}{V_b(1-\gamma_b)s + \frac{V_b \mu_b}{Z} - \frac{k^2}{V_p \mu_p \alpha}\left[1-\frac{1}{Z\alpha}\left(1-\exp(-\alpha Z)\right)\right] + k + \gamma_b E_b V_b Y_b(s)} \tag{24}$$

Rearranging the expression for α from (9)

$$\alpha = \frac{(1-\gamma_p)s}{\mu_p} + \frac{\gamma_p E_p Y_p(s)}{\mu_p} + \frac{k}{V_p \mu_p} = \frac{1}{\mu_p}\left[(1-\gamma_p)s + \gamma_p E_p Y_p(s) + \frac{k}{V_p}\right] \tag{25}$$

Define $T_p \equiv V_p/k$ and rearranging (25)

$$\alpha = \frac{1}{\mu_p T_p}\left[T_p(1-\gamma_p)s + T_p E_p \gamma_p Y_p(s) + 1\right] = \frac{1}{\mu_p T_p}\left(T_p \mathcal{s} + 1\right) \tag{26}$$

where

$$\mathcal{s} = (1-\gamma_p)s + E_p \gamma_p Y_p(s) \tag{27}$$

Substituting (26) into (24) and rearranging

$$C_{bn}(s)=\frac{\frac{V_b\mu_b}{Z}C_{fb}(s)+\frac{\mu_p V_p C_{fp}(s)}{Z(T_p s+1)}\left[1-\exp\left(-Z\frac{T_p s+1}{\mu_p T_p}\right)\right]}{V_b(1-\gamma_b)s+\frac{V_b\mu_b}{Z}\frac{k}{(T_p s+1)}\left[1-\frac{\mu_p V_p}{kZ(T_p s+1)}\left(1-\exp\left(-Z\frac{T_p s+1}{\mu_p T_p}\right)\right)\right]+k+\gamma_b V_b E_b Y_b(s)} \quad (28)$$

Define:

$$(1-B_p-B_y)=\frac{V_b\mu_b}{\mu}, \quad B_p=\frac{V_p\mu_p}{\mu}, \quad T_p=\frac{V_p}{k}=\frac{L_p}{N},$$

$$T_{vp}=\frac{V_p Z}{\mu}, \quad T_{vb}=\frac{V_b Z}{\mu}, \quad L_p=\frac{Z}{\mu_p}, \quad N=\frac{kZ}{V_p\mu_p}$$

Multiply (28) by $\frac{Z/u}{Z/u}$ and rearrange

$$C_{bn}(s)=\frac{(1-B_p-B_y)\,C_{fb}(s)+\frac{B_p C_{fp}(s)}{(T_p s+1)}\left[1-\exp\left(\frac{T_p s+1}{\mu_p T_p}Z\right)\right]}{\frac{V_b Z}{\mu}\left[(1-\gamma_b)s\right]+(1-B_p-B_y)-\left(\frac{V_p\mu_p}{\mu}\right)\left(\frac{kZ}{V_p\mu_p}\right)\frac{1}{T_p s+1}\left[1-\frac{1}{N(T_p s+1)}\left(1-\exp\left(\frac{T_p s+1}{\mu_p T_p}Z\right)\right)\right]+\left(\frac{V_p\mu_p}{\mu}\right)\left(\frac{kZ}{V_p\mu_p}\right)+T_{vb}E_b\gamma_b Y_b(s)} \quad (29)$$

Taking the following expression from (29)

$$\exp\left(-\frac{T_p s+1}{\mu_p T_p} Z\right) = \exp\left(-\frac{T_p s Z}{\mu_p T_p} - \frac{Z}{\mu_p T_p}\right) = \exp\left(-L_p s - \frac{kZ}{\mu_p V_p}\right)$$

$$= \exp -(L_p s + N) = H(s) \tag{30}$$

After substitution of (30) into (29) and further rearranging of (29)

$$C_{bn}(s) = \frac{(1-B_p-B_y)\, C_{fb}(s) + \frac{B_p C_{fp}(s)}{T_p s+1}\left[1-H(s)\right]}{(1-\gamma_b)T_{vb}s + 1 - B_y + \frac{T_{vp}s}{T_p s+1} - \frac{B_p (T_p s+2)\, T_p s}{(T_p s+1)^2} - \frac{B_p H(s)}{(T_p s+1)^2} + T_{vb} E_b \gamma_b Y_b(s)} \tag{31}$$

From (14)

$$C_{pn}(s, Z) = C_{fp}(s) \exp(-\alpha Z) + \frac{k}{V_p \mu_p \alpha}\left[1-\exp(-\alpha Z)\right] C_{bn}(s) \tag{32}$$

$$C_{pn}(s, Z) = C_{fp}(s)\, H(s) + \frac{1}{T_p s+1}\left[1-H(s)\right] C_{bn}(s) \tag{33}$$

ADSORPTION EQUATIONS

The rate of adsorption of material is given by

$$\frac{\partial q}{\partial t} = G(c, q) \tag{34}$$

The relation $G(c,q) = 0$ defines a unique equilibrium value $q_e(c)$, of q for all values of c in some given range. The adsorption process is defined as reversible and after sufficient time, the relationship $G(c,q) = 0$ is always satisfied regardless of the initial condition of the adsorbent.

A linear adsorption is assumed. That is, $G(c,q)$ is linear in c and q. If the adsorption isotherm is nonlinear, the disturbance will be adjusted so a linear approximation can be used to describe the isotherm.

Adsorption is assumed to proceed similar to the response of opposing first order reactions

$$G(c,q) = k_1 c - k_2 q \tag{35}$$

When used in the model previously described, (34) holds independently of z , the height in the column. Hence (34) can be written as an ordinary differential equation. Combining (34) and (35) ,

$$\frac{dq}{dt} = k_1 c - k_2 q \tag{36}$$

Taking the Laplace transform of (36) with $q(0) = 0$

$$s\, q(s) = k_1\, c(s) - k_2\, q(s) \tag{37}$$

Rearranging (37)

$$q(s) = \frac{k_1\, c(s)}{k_2 + s} \tag{38}$$

Since the Laplace transform of $\frac{dq}{dt} = s\, q(s)$, (38) becomes

$$s\, q(s) = \left(\frac{k_1\, s}{k_2 + s}\right) c(s) \tag{39}$$

The quantity in parentheses is defined as the admittance

$$Y'(s) = \frac{k_1\, s}{k_2 + s} = \frac{k_1}{1 + (k_2/s)} \tag{40.}$$

and

$$s\,q(s) = Y'(s)\,C(s) \tag{41}$$

Taking equation (40) and letting $s = iw$, the admittance in the frequency domain is given by

$$Y'(iw) = \frac{k_1}{1 - i(k_2/w)} \tag{42}$$

Separating into real and imaginary parts

$$Y'(iw) = Y_1(w) + i\,Y_2(w) = \frac{k_1}{1+(k_2/w)^2} + i\,\frac{k_1(k_2/w)}{1+(k_2/w)^2} \tag{43}$$

where $Y_1(w)$ and $Y_2(w)$ are known, the values of k_1 and k_2 can be found by

$$k_2 = \left(Y_2(w)/Y_1(w)\right) w \quad , \quad k_1 = \left[1 + \left(Y_2(w)/Y_1(w)\right)^2\right] Y_1(w) \tag{44}$$

If equation (35) is the correct mechanism, k_2 and k_1 should be independent of w. Solving equations (44) should yield the same values for k_1 and k_2 for all frequencies

PLUG FLOW MODEL

Equation (33) can be applied to a plug flow reactor by taking the limiting case where k = 0 and the reactor is described by a single stage.

$$C_p(s, z) = C_{fp}(s)\, H(s) = C_{fp}(s) \exp(-L_p \lambda) \tag{45}$$

Thus the transfer function of a plug flow reactor with adsorption is given by

$$\frac{C_p(s, z)}{C_{fp}(s)} = \exp(-L_p \lambda) = \exp\left\{-L_p\left[(1-\delta_p)\, s + \varepsilon_p\, \delta_p\, Y_p(s)\right]\right\} \tag{46}$$

Converting to the frequency domain by letting s = iw

$$\frac{C_p(w, z)}{C_{fp}(w)} = \exp\left\{-L_p\, \varepsilon_p\, \delta_p\, Y_1(w) - i\, L_p\left[(1-\delta_p)\, w + \delta_p\, \varepsilon_p\, Y_2(w)\right]\right\} \tag{47}$$

where

$$Y_p(w) = Y_1(w) + i\, Y_2(w) \tag{48}$$

The resulting vector can be described by a magnitude and an angle defined previously as the amplitude ratio and the phase angle ϕ.

$$M.R. = A.R. = \exp -[L_p E_p \gamma_p Y_1(w)] \tag{49}$$

$$\phi = -L_p\left[(1-\gamma_p)\, w + \gamma_p E_p Y_2(w)\right] \tag{50}$$

By determining the transfer function experimentally, the values $Y_1(w)$ and $Y_2\ (w)$ can be found for each w. Therefore

$$Y_1(w) = \frac{-\ln\ A.R.}{L_p \gamma_p E_p} \tag{51}$$

$$Y_2(w) = \frac{\phi + L_p(1-\gamma_p)w}{-L_p \gamma_p E_p} \tag{52}$$

The values of the rate constants for adsorption can then be found using equation (44).

APPENDIX III

COMPUTER PROGRAMS

```
FORTRAN IV011 SOURCE PROGRAM                                    01/29/69    PAGE 0001

      PROGRAM DPLS                                                       DPLS   1
C     PROGRAM PULSE. ARRAY DESCRIPTION.F-TIME DEPENDENT VARIABLE,F(1)    DPLS   2
C     ARE BASE LINES.CA,CB,CC --- A,B,C DESCRIBED IN AICHE J VOL 13 NO 2DPLS   3
C     P 374. SA,SB,SC --- COEFFICIENTS OF GENERAL EQUATION F(T)= SA*T**2DPLS   4
C     +SB*T+SC IN THE INTERVAL. T -- TIME. NC ---NO OF CARDS IN A SINGLEDPLS   5
C     PULSE DATA SET. NF -- NO OF FIELDS USED ON LAST CARD OF DATA SET. DPLS   6
C     DT--- INCREMENTS OF TIME. NT1 --- NO OF TIME INTERVALS FOR         DPLS   7
C     FIRST DELTA T INCREMENTS. RO -- AREA UNDER CURVE. IF INDEX=1 STEP-DPLS   8
C     WISE APPROXIMATIONS ARE USED  INDEX=2 STRAIGHT  INDEX=3 PARA-      DPLS   9
C     BOLIC                                                              DPLS  10
C     IF L=1 INPUT PULSE  L=2 OUTPUT PULSE.                              DPLS  11
C                                                                        DPLS  12
      DIMENSION F(101,2),CA(100,2),CB(100,2),CC(100,2),SA(101,2),SB(101,DPLS  13
     12),SC(101,2),T(101,2),NC(2),NF(2),DT(2,2),NT1(2),RO(2),INDEX(2),  DPLS  14
     2N(2),R(2),FIM(2),COMM(20),MTIM(2),JTIM(2),CAL(2)                   DPLS  15
      DOUBLE PRECISION AR,CA,CB,CC,F,FIM,OM,OMF,OMS,PHI,R,RO,SA,SB,SC,  DPLS  16
     1SW,SWN,T,TEM,TEM1,TEM2,TFI,TFR,TIM,TRUN,Z,CAL,DT,DTIM              DPLS  17
      DATA IVER/'QUIT'/,IDIR/'1'/,MTIM(2)/'1'/,MTIM(1)/'1'/,NMLC/'1'/,  DPLS  18
     1LTIC/'1'/,IZER/'0'/                                                DPLS  19
   53 READ 81,INDEX(1),NC(1),NF(1),DT(1,1),NT1(1),DT(2,1),JTIM(1),IDEL, DPLS  20
     1INDEX(2),NC(2),NF(2),DT(1,2),NT1(2),DT(2,2),JTIM(2),NML,LTIM,DTIM,DPLS  21
     1OMS,OMF,CAL(1),CAL(2),ID                                           DPLS  22
   81 FORMAT(2(I1,2I2,F4.1,I2,F4.1,2A1),A1,F4.1,4F6.2,13X,A4)            DPLS  23
      TIM=0.                                                             DPLS  24
```

```
C     CHECK FOR TERMINATION CARD                                        DPLS  25
      IF(IVER-ID)55,54,55                                               DPLS  26
55    READ 85,(COMM(I),I=1,20)                                          DPLS  27
85    FORMAT(20A4)                                                      DPLS  28
C     IF NO INPUT PULSE DATA, PROGRAM ASSUMES DIRAC DELTA               DPLS  29
C     CHECK FOR DIRAC DELTA INPUT                                       DPLS  30
      IF(IDIR-IDEL)1,2,1                                                DPLS  31
2     L=2                                                               DPLS  32
      IRAC=2                                                            DPLS  33
      RO(1)=1.                                                          DPLS  34
      GO TO 100                                                         DPLS  35
1     L=1                                                               DPLS  36
      IRAC=1                                                            DPLS  37
100   NP=(12*(NC(L)-1))+NF(L)                                           DPLS  38
      N(L)=NP                                                           DPLS  39
      READ 82,(F(I,L),I=1,NP)                                           DPLS  40
82    FORMAT(12F6.1)                                                    DPLS  41
C     CALCULATE VALUES FROM CALIBRATING CURVE                           DPLS  42
      DO 336 I=1,NP                                                     DPLS  43
336   F(I,L)=F(I,L)*CAL(L)                                              DPLS  44
C     CHECK IF TIMES ARE TO BE READ                                     DPLS  45
      IF(MTIM(L)-JTIM(L))102,101,102                                    DPLS  46
C     IF NO DELTA T SPECIFIED PROGRAM READS NEXT DATA SET AS TIMES      DPLS  47
101   READ 82,(T(I,L),I=1,NP)                                           DPLS  48
      GO TO 103                                                         DPLS  49
C     TIME CALCULATED FROM DELTA T VALUES                               DPLS  50
```

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```
 102   T(1,L)=0.                                   DPLS  51
       T(2,L)=0.                                   DPLS  52
       IF(DT(2,L))105,105,106                      DPLS  53
 C     2 DELTA T SPECIFIED                         DPLS  54
 106   ITEM=NT1(L)                                 DPLS  55
       DO 104 I=1,ITEM                             DPLS  56
       Z=I                                         DPLS  57
 104   T(I+2,L)=Z*DT(1,L)                          DPLS  58
       IDUM=NP-ITEM-2                              DPLS  59
       ITEM=ITEM+2                                 DPLS  60
       DO  107 I=1,IDUM                            DPLS  61
       Z=I                                         DPLS  62
       IT=ITEM+I                                   DPLS  63
 107   T(IT,L)=T(ITEM,L)+Z*DT(2,L)                 DPLS  64
       GO TO 103                                   DPLS  65
 C     ONE DELTA T SPECIFIED                       DPLS  66
 105   ITEM=NP-2                                   DPLS  67
       DO 108 I=1,ITEM                             DPLS  68
       Z=I                                         DPLS  69
 108   T(I+2,L)=Z*DT(1,L)                          DPLS  70
 103   NINT=NP-1                                   DPLS  71
 C     INITIALIZE                                  DPLS  72
       DO 3 I=1,NP                                 DPLS  73
       CA(I,L)=0.                                  DPLS  74
```

```
      CB(I,L)=0.                                                        DPLS  75
      CC(I,L)=0.                                                        DPLS  76
      SA(I,L)=0.                                                        DPLS  77
      SB(I,L)=0.                                                        DPLS  78
    3 SC(I,L)=0.                                                        DPLS  79
      SWN=1.                                                            DPLS  80
C     CORRECT DATA TO ZERO BASELINE                                     DPLS  81
      DO 110 I=2,NP                                                     DPLS  82
  110 F(I,L)=F(I,L)-F(1,L)                                              DPLS  83
      F(1,L)=0.                                                         DPLS  84
      IND=INDEX(L)                                                      DPLS  85
C     GO TO SPECIFIED APPROXIMATION                                     DPLS  86
      GO TO (21,22,23),IND                                              DPLS  87
C     STEPWISE APPROXIMATION                                            DPLS  88
   21 IF(L-2)211,25,25                                                  DPLS  89
  211 IF(F(3,L)-F(1,L))25,26,25                                         DPLS  90
   26 F(2,L)=2.*F(2,L)                                                  DPLS  91
   25 DO 28 I=2,NINT                                                    DPLS  92
   28 SC(I,L)=(F(I,L)+F(I+1,L))/2.                                      DPLS  93
      DO 136 I=2,NP                                                     DPLS  94
  136 CA(I,L)=SC(I,L)-SC(I-1,L)                                         DPLS  95
      GO TO 24                                                          DPLS  96
C     STRAIGHT LINE APPROXIMATION                                       DPLS  97
   22 DO 31 I=2,NINT                                                    DPLS  98
      SB(I,L)=(F(I,L)-F(I+1,L))/(T(I,L)-T(I+1,L))                       DPLS  99
   31 SC(I,L)=(F(I,L)+F(I+1,L)-SB(I,L)*(T(I,L)+T(I+1,L)))/2.            DPLS 100
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           CA(2,L)=F(2,L)-F(1,L)                                                DPLS 101
           CA(NP,L)=F(NP,L)-F(1,L)                                              DPLS 102
           DO 236 I=2,NP                                                        DPLS 103
     236   CB(I,L)=SB(I,L)-SB(I-1,L)                                            DPLS 104
           GO TO 24                                                             DPLS 105
     C     PARABOLIC APPROXIMATION                                              DPLS 106
     23    IDUM=NINT-1                                                          DPLS 107
           DO 34 I=2,IDUM                                                       DPLS 108
           TEM=T(I,L)*(T(I+2,L)**2 -T(I+1,L)**2 )+T(I+1,L)*(T(I,L)**2 -T(I+2,DPLS 109
          1L)**2 )+T(I+2,L)*(T(I+1,L)**2 -T(I,L)**2 )                          DPLS 110
           SA(I,L)=((T(I+1,L)-T(I+2,L))*(F(I,L)-F(I+1,L))-(T(I,L)-T(I+1,L))* DPLS 111
          1(F(I+1,L)-F(I+2,L)))/TEM                                             DPLS 112
           SB(I,L)=((F(I,L)-F(I+1,L))*(T(I+1,L)**2-T(I+2,L)**2)-(F(I+1,L)      DPLS 113
          1-F(I+2,L))*(T(I,L)**2-T(I+1,L)**2))/(-TEM)                          DPLS 114
     34    SC(I,L)=(F(I,L)+F(I+1,L)+F(I+2,L)-SA(I,L)*(T(I,L)**2 +T(I+1,L)**2 DPLS 115
          1+T(I+2,L)**2 )-SB(I,L)*(T(I,L)+T(I+1,L)+T(I+2,L)))/3.              DPLS 116
     C     LAST TWO INTERVALS, USE SAME APPROXIMATING CURVE                    DPLS 117
           SA(NINT,L)=SA(IDUM,L)                                                DPLS 118
           SB(NINT,L)=SB(IDUM,L)                                                DPLS 119
           SC(NINT,L)=SC(IDUM,L)                                                DPLS 120
           CA(2,L)=F(2,L)-F(1,L)                                                DPLS 121
           CA(NP,L)=F(NP,L)-F(1,L)                                              DPLS 122
           DO 36 I=2,NP                                                         DPLS 123
           CB(I,L)=(2.*SA(I,L)*T(I,L)+SB(I,L))-(2.*SA(I-1,L)*T(I,L)+SB(I-1,L)DPLS 124
```

```
       1)                                                               DPLS 125
   36  CC(I,L)=2.*(SA(I,L)-SA(I-1,L))                                   DPLS 126
 C     CALCULATE AREAS UNDER CURVES USING SPECIFIED APPROXIMATION       DPLS 127
   24  RO(L)=0.                                                         DPLS 128
       DO 35 I=2,NINT                                                   DPLS 129
   35  RO(L)=RO(L)+(SA(I,L)*(T(I+1,L)**3 -T(I,L)**3 )/3.)+(SB(I,L)*(T(I+1DPLS 130
      1,L)**2 -T(I,L)**2 )/2.)+(SC(I,L)*(T(I+1,L)-T(I,L)))              DPLS 131
 C     SAVE VALUE IF CURVE IS TRUNCATED BY THE PROGRAM                  DPLS 132
       TRUN=F(NP,L)                                                     DPLS 133
       F(NP,L)=F(1,L)                                                   DPLS 134
 C     IF INPUT PULSE CALCULATIONS DONE DO OUTPUT PULSE                 DPLS 135
       IF(2-L)38,38,39                                                  DPLS 136
   39  L=2                                                              DPLS 137
       GO TO 100                                                        DPLS 138
 C     INITIALIZE                                                       DPLS 139
   38  DM=0.                                                            DPLS 140
       PHI=0.                                                           DPLS 141
       FIM(1)=0.                                                        DPLS 142
       FIM(2)=0.                                                        DPLS 143
       R(1)=1.                                                          DPLS 144
       ILN=7                                                            DPLS 145
       AR=RO(2)/RO(1)                                                   DPLS 146
       PRINT 83,ID                                                      DPLS 147
   83  FORMAT(1H1///50X,'RUN ID ',A4/)                                  DPLS 148
       PRINT 87,(COMM(I),I=1,20)                                        DPLS 149
   87  FORMAT(11X,'COMMENTS  ',20A4/)                                   DPLS 150
```

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FORTRAN IV011 SOURCE PROGRAM  DPLS      PROGRAM                    01/29/69   PAGE 0004

         IF(NMLC-NML)68,67,68                                                     DPLS 151
    67   PRINT 89,TIM                                                             DPLS 152
    89   FORMAT(20X,'DEAD TIME= ',G10.3,2X,'PULSES NORMALIZED'/)                  DPLS 153
         GO TO 69                                                                 DPLS 154
    68   PRINT 90,TIM                                                             DPLS 155
    90   FORMAT(20X,'DEAD TIME= ',G10.3,2X,'PULSES NOT NORMALIZED'/)              DPLS 156
    69   PRINT 86                                                                 DPLS 157
    86   FORMAT(10X,'OMEGA',4X,'AMPLITUDE',2X,'PHASE ANGLE',4X,'OUTPUT PULSDPLS 158
        1E',11X,'INPUT PULSE',6X,'INPUT FREQ CONTENT'/9X,'RAD/SEC',5X,'RATIDPLS 159
        2O',6X,'DEGREES',5X,'REAL',4X,'IMAGINARY',5X,'REAL',4X,'IMAGINARY' DPLS 160
        3,2X,'NORMALIZED',3X,'ACTUAL'//)                                         DPLS 161
         PRINT 84,OM,AR,PHI,RO(2),FIM(2),RO(1),FIM(1),SWN,RO(1)                   DPLS 162
         OM=OMS                                                                   DPLS 163
    44   DO 40 L=IRAC,2                                                           DPLS 164
         FIM(L)=0.                                                                DPLS 165
         R(L)=0.                                                                  DPLS 166
         NP=N(L)                                                                  DPLS 167
         DO 40 I=2,NP                                                             DPLS 168
         TEM=OM*T(I,L)                                                            DPLS 169
         ITEM=(OM*T(I,L))/(2.*3.14159)                                            DPLS 170
         TEM1=ITEM                                                                DPLS 171
         TEM=TEM-(TEM1*2.*3.14159)                                                DPLS 172
         TEM1=(-CA(I,L)/OM)+(CC(I,L)/(OM**3))                                     DPLS 173
         TEM2=-CB(I,L)/(OM*OM)                                                    DPLS 174
```

```
      R(L)=R(L)+TEM1*DSIN(TEM)+TEM2*DCOS(TEM)                          DPLS 175
   40 FIM(L)=FIM(L)+TEM1*DCOS(TEM)-TEM2*DSIN(TEM)                      DPLS 176
      TEM=R(1)*R(1)+FIM(1)*FIM(1)                                      DPLS 177
      TFR=(R(2)*R(1)+FIM(2)*FIM(1))/TEM                                DPLS 178
      TFI=(R(1)*FIM(2)-R(2)*FIM(1))/TEM                                DPLS 179
      AR=DSQRT(TFR*TFR+TFI*TFI)                                        DPLS 180
      TEM=TFI/TFR                                                      DPLS 181
      CALL DVCHK(J)                                                    DPLS 182
      IF(J-2)51,50,50                                                  DPLS 183
   51 PHI=DATAN2(TFR,TFI)*(180./3.14159)+90.                           DPLS 184
      GO TO 52                                                         DPLS 185
   50 PHI=DATAN2(TFI,TFR)*180./3.14159                                 DPLS 186
   52 SW=DSQRT(R(1)*R(1)+FIM(1)*FIM(1))                                DPLS 187
      SWN=SW/RO(1)                                                     DPLS 188
      IF(NMLC-NML)64,63,64                                             DPLS 189
C     NORMALIZE BOTH PULSES                                            DPLS 190
   63 AR=AR*(RO(1)/RO(2))                                              DPLS 191
      DO 62 NORM=1,2                                                   DPLS 192
      R(NORM)=R(NORM)/RO(NORM)                                         DPLS 193
   62 FIM(NORM)=FIM(NORM)/RO(NORM)                                     DPLS 194
   64 PRINT 84,OM,AR,PHI,R(2),FIM(2),R(1),FIM(1),SWN,SW                DPLS 195
   84 FORMAT(8X,9(G10.3,1X ))                                          DPLS 196
      ILN=ILN+1                                                        DPLS 197
      IF(ILN-34)60,60,61                                               DPLS 198
   61 ILN=7                                                            DPLS 199
      PRINT 83,ID                                                      DPLS 200
```

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```
      PRINT 88                                                   DPLS 201
88    FORMAT(54X,'CONTD.'/)                                      DPLS 202
      IF(NMLC-NML)71,70,71                                       DPLS 203
70    PRINT 89,TIM                                               DPLS 204
      GO TO 72                                                   DPLS 205
71    PRINT 90,TIM                                               DPLS 206
72    PRINT 86                                                   DPLS 207
60    ITEM=DLOG10(OM)-0.99                                       DPLS 208
      IF(OM-10.)300,300,301                                      DPLS 209
301   ITEM=ITEM+1                                                DPLS 210
300   OM=OM+10.**ITEM                                            DPLS 211
      IF(OMF-OM)43,44,44                                         DPLS 212
C     IF DEAD TIME DO CALCS W/O DEAD TIME,THEN WITH DEAD TIME    DPLS 213
43    IF(LTIC-LTIM)53,65,53                                      DPLS 214
65    L=2                                                        DPLS 215
      NP=N(L)                                                    DPLS 216
      F(NP,L)=TRUN                                               DPLS 217
      DO 66 I=2,NP                                               DPLS 218
66    T(I,L)=T(I,L)+DTIM                                         DPLS 219
      LTIM=IZER                                                  DPLS 220
      TIM=DTIM                                                   DPLS 221
      GO TO 103                                                  DPLS 222
54    CONTINUE                                                   DPLS 223
      STOP                                                       DPLS 224
      END                                                        DPLS 225
```

INPUT FORMAT FOR DPLS

CONTROL CARD

COL.		INPUT PULSE
1	(1)	Type of approximation to be used. 1-step, 2-straight line segments, 3-parabolic
2-3	(2)	No. of cards for input pulse, f(t).
4-5	(3)	No. of data points on last card.
6-9	(4)	Δt_1 increments for first part of pulse, if applicable.
10-11	(5)	No. of Δt_1 increments. If no Δt_2 increments, leave blank, program will compute proper number of increments.
12-15	(6)	Δt_2 increments for second part of pulse, if applicable. If not, leave blank.
16	(7)	Read individual times instead of using Δt increments. 0 for no, 1 for yes.
17	(8)	Is dirac delta used for input? 0 for no, 1 for yes. If yes, entries 4-6 inclusive can be left blank.
		OUTPUT PULSE
18	(9)	Same as (1).
19-20	(10)	No. of cards for output pulse.
21-22	(11)	No. of data points on last card.
23-26	(12)	Same as (4).
27-28	(13)	Same as (5).
29-32	(14)	Same as (6).
33	(15)	Same as (7).
34	(16)	Normalize pulses? 0 if no, 1 if yes.
35	(17)	Is dead time used separately for pulse? 0 if no,

COL.	OUTPUT PULSE	
		1 if yes. If yes, results are calculated with dead time and w/o dead time.
36-39	(18)	Dead time, if applicable.
40-45	(19)	Initial value of frequency for analysis must not be 0.
46-51	(20)	Value of frequency at finish of job must not be 0.
52-57	(21)	Slope of input calibration curve.
58-63	(22)	Slope of output calibration curve.
77-80	(23)	Run ID. - printed on output sheets.

COMMENT CARD

For descriptive comments on output sheet. A card must be included. Only one is to be used.

INPUT PULSE f(t)

First entry is baseline. 2nd entry is f(t) @ t = 0. If dirac input pulse is used, omit card. Twelve (12) entries per card. Six column fields.

INPUT PULSE (t)

If applicable, entries are in one-to-one correspondence with pulse cards. If not applicable, omit cards. Twelve (12) entries per card. Six column fields.

OUTPUT PULSE f(t)

Same as for input pulse.

OUTPUT PULSE (t)

Same as for input pulse.

Succeeding data sets use same format as above. They are placed one after another.

TERMINATION CARD

Last card in the last data set causes normal exit of program. "QUIT" punched in columns 77-80.

```
NLIN1          12:57      04/16/70

100C PRØGRAM NLIN1--NONLINEAR LEAST SQUARES
110C BY D. W. MARQUARDT
120C REPRØGRAMMED IN FØRTRAN IV FØR GE MARK II TIME-SHARING
130C MAX NØ ØF PARAMETERS IS K.       MAX NØ ØF IND. VARS. IS M
140C MAX NØ ØF ØBSERVATIØNS IS N
150C DIMENSIØN PRNT(5),CØNS(5),IWS(6)
160C DIMENSIØN X(N,M),B(K),Y(N),A(2K,K),P(K)
170C DIMENSIØN BS(K),DB(K),BA(K),G(K),IB(K-1),SA(K)
180C CALL SUBZ
190C         CØDING FØR CASE INITIALIZING
200C CALL FCØDE
210C         F IS Y HAT(I)
220C         NPRNT IS THE NØ ØF ØTHER WØRDS TØ BE PRINTED
230C         THE WØRDS TØ BE PRINTED ARE IN PRNT(1).....PRNT(5)
240C CALL PCØDE
250C         CØDING TØ MAKE DF/DB GØES HERE
260C        MAKE K ØF THEM.  CALL THEM P(J),J=1,K
270C        THEY ARE MADE FRØM X(I,L) AND B(J)
280      DIMENSIØN PRNT(5),CØNS(5),IWS(6)
290      DIMENSIØN X(25,1),B(12),Y(25),A(24,12),P(12)
300      DIMENSIØN BS(12),DB(12),BA(12),G(12),IB(11),SA(12)
310 CØMMØN X,B,PRNT,A,P
320 CØMMØN Y
330 CØMPLEX Y
340      DATA IBCH/" "/,IØCH/"0"/,IPCH/"P"/,IYCH/"Y"/,IXCH/"X"/,NPRNT/Ø
350C READ FIRST CARD ØF NEXT CASE
```

```
360     10 ITCT=0
370        IBØUT=0
380 PRINT 900
390 INPUT,N,K,IP,M,IFP,NCØNS
400        NTILDA=N+NCØNS
410        XNT=NTILDA
420C END ØF LAST PRØBLEM
430        IF(N.LE.0) GØ TØ 660
440 PRINT 901
450 INPUT,(IWS(I),I=1,6)
460        IF (IFP.LE.0)GØ TØ 22
470 PRINT 929
480 INPUT,YMN,SPRD
490     22 IF(IP.LE.0) GØTØ 30
500 PRINT 930,IP
510 INPUT,(IB(I),I=1,IP)
520        DØ 26 I=1,IP
530        IF (IB(I).GT.0)GØ TØ 26
540 PRINT 926
550        IBØUT=1
560     26 CØNTINUE
570 30 PRINT 931
580 INPUT,FF,T,E,TAU,XL,GAMCR,DEL,ZETA
590C DUB IN UNPUT CØNSTANTS IF NØT SUPPLIED
600C (XL IS CHECKED IN FIRST ITERATIØN)
610        IF(FF.GT.0.) GØTØ 34
620        FF=4.
630     34 IF(E.GT.0.) GØTØ 37
640        E=.00005
650     37 IF(TAU.GT.0.) GØTØ 39
```

```
          TAU=.001
 39       IF(T.GT.0.) GØ TØ 50
          T=2.
      50  IF(GAMCR.GT. 0.) GØTØ 52
          GAMCR = 45.
      52  IF (DEL.GT. 0.) GØ TØ 55
          DEL=.00001
      55  IF (ZETA.GT. 0.) GØ TØ 53
          ZETA=.1E-30
      53  XKDB = 1.
PRINT 932,K
C READ IN INITIAL B GUESSES
INPUT,(B(I),I=1,K)
PRINT 942,M
          DØ 56 I=1,N
56 INPUT,Y(I),(X(I,L),L=1,M)
          CALL SUBZ(NPRNT,N)
          IF(IBØUT.NE.0) GØ TØ 10
          IBKA=1
C START THE CALCULATION ØF THE PTP MATRIX
PRINT 907,N,K,IP,M,IFP,GAMCR,DEL,FF,T,E,TAU,XL,ZETA
          GØ TØ 61
 60       IWS(3)=IWS(3)-1
          IF(IWS(3).GT.0) GØ TØ 61
          IWS(3)=0
 61       DØ 62 I=1,K
          G (I) =0.
          DØ 62 J=1,K
      62  A (I,J)=0.
PRINT 908,ITCT,(B(J),J=1,K)
```

```
      IF(IWS(3).EQ.0) GØ TØ 73
      IF (IFP.LE.0)GØ TØ 68
      WS = YMN+SPRD
 PRINT 906,YMN,WS
       GØ TØ 73
 68 PRINT 910
     73 I=1
       PHI=0.
       PHIN=0.
       ICONS=1
C GET P S AND F
 72    IF(IWS(2).EQ.1) GØ TØ 602
C THIS IS THE ANALYTICAL P S RØUTINE
       CALL FCØDE(F,I,RES)
       CALL PCØDE(F,I)
       IF (IP.LE.0)GØ TØ 80
       DØ 77 II=1,IP
       KWS=IB(II)
 77    P(KWS)=0.
       GØ TØ 80
C END ØF ANALYTICAL P S RØUTINE
C THIS IS THE ESTIMATED P S RØUTINE
 602   CALL FCØDE(F,I,RES)
       RWS=RES
       FSAVE=F
       J=1
  608  IF (IP.LE.0)GØ TØ 618
       DØ 612 II=1,IP
       IF ((J-IB(II)).EQ.0)GØ TØ 621
  612  CONTINUE
```

```
1260   618 DBW=B(J)*DEL
1270       TWS=B(J)
1280       B(J)=B(J)+DBW
1290       CALL FCØDE(F,I,RES)
1300       B(J)=TWS
1310       P(J)=-(RES-RWS)/DBW
1320       GØ TØ 622
1330   621 P(J)=0.
1340   622 J=J+1
1350       IF ((J-K).LE.0)GØ TØ 608
1360       RES=RWS
1370       F=FSAVE
1380C END ØF ESTIMATED P S RØUTINE
1390C NØW, USE THE P S TØ MAKE PARTIALS MATRIX
1400    80 DØ 82 JJ=1,K
1410       G(JJ)=G(JJ)+RES*P(JJ)
1420       DO 82 II=JJ,K
1430       A(II,JJ)=A(II,JJ)+P(II)*P(JJ)
1440    82 A(JJ,II)=A(II,JJ)
1450C PLØTTING RØUTINE
1460       IF (IFP.LE.0)GØ TØ 318
1470       IF(IWS(3).EQ.0.ØR.I.GT.N) GØ TØ 314
1480C PLØTTING Y(I),F
1490       YI=CABS(Y(I))
1500 YI=ALØG(YI)/2.303
1510 FI=ALØG(F)/2.303
1520 IØ=(YI-YMN)*50./SPRD
1530 IPP=(FI-YMN)*50./SPRD
1540       IF (IØ.EQ.IPP)GØ TØ 808
1550       IF (IØ.GT. IPP)GØ TØ 812
```

```
1560C Y(I) ØUT FIRST
1570        IP1=IØCH
1580        IP2=IPCH
1590        I1=IØ
1600        I2=IPP
1610        GØ TØ 816
1620C ØNLY ØNE CHARACTER
1630   808 IP1=IYCH
1640        IP2=IBCH
1650        I1=IØ
1660        I2=IPP
1670        GØ TØ 816
1680C F ØUT FIRST
1690   812 IP1=IPCH
1700        IP2=IØCH
1710        I1=IPP
1720        I2=IØ
1730C ZERØ PLØTS IN THE LEFT HAND CØLUMN, SØ
1740C I1 IS ITS ØWN BLANK CØUNTER
1750C ØVERFLØWS PLØT X IN CØLUMN 51
1760C UNDERFLØWS ALSØ PLØT X IN CØLUMN ZERØ
1770 816 IF(I2.LE.51) GØ TØ 819
1780 I2=51
1790        IP2=IXCH
1800 IF(I1.LT.51) GØ TØ 819
1810 I1=51
1820        IP1=IXCH
1830        IP2=IBCH
1840        GØ TØ 825
1850  819   IF (I1.GE.0)GØ TØ 825
```

```
      I1=0
      IP1=IXCH
      IF (I2.GT.0)GO TO 825
      I2=1
      IP2=IBCH
  825 I1M1=I1
      I1M2=I2-I1-1
      IF (I1M1.GT.0)GO TO 832
      IF (I1M2.GT.0)GO TO 828
PRINT 928,IP1,IP2
      GO TO 314
828 PRINT 928,IP1,(IBCH,II=1,I1M2),IP2
      GO TO 314
 832  IF (I1M2.GT.0)GO TO 840
PRINT 928,(IBCH,II=1,I1M1),IP1,IP2
      GO TO 314
840 PRINT 928,(IBCH,II=1,I1M1),IP1,(IBCH,II=1,I1M2),IP2
      GO TO 314
C END OF PLOTTING ROUTINE
 318  WS=RES
      IF(IWS(3).EQ.0.OR.I.GT.N) GO TO 314
      IF (NPRNT.GT.0)GO TO 312
      YI=CABS(Y(I))
PRINT 925,YI,F,WS
      GO TO 314
312   YI=CABS(Y(I))
PRINT 925,YI,F,WS,(PRNT(JJ),JJ=1,NPRNT)
 314  WS=RES
      PHI=PHI+WS*WS
      IF (I.GT.N) GO TO 313
```

```
        PHIN=PHIN+WS*WS
        GØ TØ 315
  313   CØNS(ICØNS)=RES
        ICØNS=ICØNS+1
  315   I=I+1
        IF (I.LE.NTILDA) GØ TØ 72
        IF (IP.LE.0)GØ TØ 88
        DØ 87 JJ=1,IP
        KWS=IB(JJ)
        DØ 86 II=1,K
        A(KWS,II)=0.
 86     A(II,KWS)=0.
 87     A(KWS,KWS)=1.
  88    GØ TØ (90,704,703),IBKA
C SAVE SQUARE RØØTS ØF DIAGØNAL ELEMENTS
     90 DØ 92 I=1,K
  92    SA(I)=SQRT (A(I,I))
        DØ 106 I=1,K
        DØ 100 J=1,K
        WS = SA(I)*SA(J)
        IF(WS.GT.0.) GØTØ 98
        A(I,J) =0.
        GØ TØ 100
     98 A(I,J)=A(I,J)/WS
    100 CONTINUE
        IF(SA(I).GT.0.) GØTØ 104
        G(I)=0.
        GØ TØ 106
    104 G(I)=G(I)/SA(I)
    106 CØNTINUE
```

```
      DØ 110 I=1,K
  110 A(I,I)=1.
      PHIZ=PHI
C WE NØW HAVE PHI ZERØ
      DØ 1133 II=1,K
      III=II+K
      DØ 1133 JJ=1,K
 1133 A(III,JJ)=A(II,JJ)
      IF (ITCT.NE.0) GØ TØ 163
C FIRST ITERATIØN
      IF(XL.GT.0.) GØTØ 154
      XL=0.01
  154 DØ 161 J=1,K
  161 BS(J)=B(J)
C BS(J) CØRRESPØNDS TØ PHIZ
  163 IBK1=1
      WS=N-K+IP
      ITCT=ITCT+1
      SE=SQRT(PHIN/WS)
      IF(IWS(3).GT.0) GØ TØ 165
      IF(IWS(2).EQ.0) GØ TØ 168
PRINT 911,PHIZ,SE,XLL,GAMMA,XL
      GØ TØ 200
168 PRINT 912,PHIZ,SE,XLL,GAMMA,XL
      GØ TØ 200
 165  IF (NCØNS.EQ.0) GØ TØ 166
PRINT 938,(JJ,CØNS(JJ),JJ=1,NCØNS)
166 PRINT 939
      DØ 114 I=1,K
PRINT 937,I,(A(I,J),J=1,K)
```

```
 114  CONTINUE
      IF(IWS(2).EQ.0) GØ TØ 1661
PRINT 903,PHIZ,SE,XL
      GØ TØ 200
1661 PRINT 909,PHIZ,SE,XL
      GØ TØ 200
  164 PHIL=PHI
C WE NØW HAVE PHI LAMBDA
      DØ 170 J=1,K
      IF (ABS(DB(J)/(ABS(B(J)) + TAU)).GE.E) GØTØ 172
  170 CØNTINUE
PRINT 923
      GØ TØ 700
172   IF(IWS(4).EQ.0) GØ TØ 173
      IF(IWS(4).EQ.1) GØ TØ 171
      IWS(4)=IWS(4)-1
      GØ TØ 173
171 PRINT 924
      GØ TØ 700
  173 XKDB = 1.
      IF (PHIL.GT.PHIZ)GØ TØ 190
      XLS=XL
      DØ 176 J=1,K
      BA(J)=B(J)
  176 B(J)=BS(J)
      IF (XL.GT..00000001)GØ TØ 175
      DØ 1176 J=1,K
      B(J)=BA(J)
 1176 BS(J)=B(J)
      GØ TØ 60
```

```
3060   175 XL=XL/10.
3070       IBK1=2
3080       GØ TØ 200
3090   177 PHL4=PHI
3100C WE NOW HAVE PHI(LAMBDA/10)
3110       IF(PHL4.GT.PHIZ) GØTØ 184
3120       DØ 183 J=1,K
3130   183 BS(J)=B(J)
3140       GØ TØ 60
3150   184 XL=XLS
3160       DØ 186 J=1,K
3170       BS(J)=BA(J)
3180   186 B(J)=BA(J)
3190       GØ TØ 60
3200   190 IBK1=4
3210       XLS=XL
3220       XL=XL/10.
3230       DØ 185 J=1,K
3240   185 B(J)=BS(J)
3250       GØ TØ 200
3260  187  IF (PHI.LE.PHIZ)GØ TØ 196
3270       XL=XLS
3280       IBK1=3
3290   192 XL=XL*10.
3300   195 DØ 193 J=1,K
3310   193 B(J)=BS(J)
3320       GØ TØ 200
3330   194 PHIT4=PHI
3340C WE NØW HAVE PHI(10*LAMBDA)
3350       IF (PHIT4.GT.PHIZ)GØ TØ 198
```

```
  196 DØ 197 J=1,K
  197 BS(J)=B(J)
      GØ TØ 60
 198  IF (GAMMA.GE.GAMCR)GØ TØ 192
      XKDB = XKDB/2.
      DØ 1199 J=1,K
      IF (ABS(DB(J)/(ABS(B(J))+TAU)).GE.E)GØ TØ 195
 1199 CONTINUE
      DØ 1200 J=1,K
 1200 B(J)=BS(J)
PRINT 934
      GØ TØ 700
C SET UP FØR MATRIX INVERSIØN
200   DØ 1103 II=1,K
      III=II+K
      DØ 1103 JJ=1,K
 1103 A(II,JJ)=A(III,JJ)
      DØ 202 I=1,K
  202 A(I,I)=A(I,I)+XL
C GET INVERSE ØF A AND SØLVE FØR DB(J) S
      IBKM=1
C THIS IS THE MATRIX INVERSIØN RØUTINE
C K IS THE SIZE ØF THE MATRIX
404   CALL GJR(K,ZETA,MSING)
      GØ TØ (415,10),MSING
  415 GØ TØ (416,710), IBKM
C END ØF MATRIX INVERSIØN, SØLVE FØR DB(J)
  416 DØ 420 I=1,K
      DB(I)=0.
      DØ 421 J=1,K
```

```
  421 DB(I)=A(I,J)*G(J)+DB(I)
  420 DB(I)=XKDB*DB(I)
      XLL=0.
      DTG = 0.
      GTG = 0.
      DØ 250 J=1,K
      XLL=XLL+DB(J)*DB(J)
      DTG = DTG + DB(J)*G(J)
      GTG = GTG + G(J)**2
      DB(J)=DB(J)/SA(J)
  250 B(J)=B(J)+DB(J)
      KIP=K-IP
      IF (KIP.EQ.1) GØ TØ 1257
      CGAM=DTG/SQRT(XLL*GTG)
      JGAM = 1
      IF(CGAM.GT..0) GØTØ 253
      CGAM = ABS(CGAM)
      JGAM = 2
253   GAMMA=57.2958*(1.57073+CGAM*(-0.212114+CGAM*(0.074261
&-CGAM*.0187293)))*SQRT(1.-CGAM)
      GØ TØ (257,255), JGAM
  255 GAMMA = 180.-GAMMA
      IF (XL.LT.1.0)GØ TØ 257
PRINT 922,XL,GAMMA
      GØ TØ 700
 1257 GAMMA=0.
  257 XLL=SQRT(XLL)
      IBK2=1
      GØ TØ 300
252   IF(IWS(3).EQ.0) GØ TØ 256
```

```
3960 PRINT 904,(DB(J),J=1,K)
3970 PRINT 905,PHI,XL,GAMMA,XLL
3980   256 GØ TØ (164,177,194,187),IBK1
3990C CALCULATE PHI
4000   300 I=1
4010        PHI=0.
4020        PHIN=0.
4030 800    CALL FCØDE(F,I,RES)
4040        PHI=PHI+(RES**2)
4050        IF (I.GT.N) GØ TØ 305
4060        PHIN=PHIN+RES*RES
4070  305   I=I+1
4080        IF(I.LE.NTILDA) GØ TØ 800
4090        GØ TØ (252,780,704,762,766,772),IBK2
4100C THIS IS THE CØNFIDENCE LIMIT CALCULATIØN
4110   700 DØ 702 J=1,K
4120   702 B(J)=BS(J)
4130 PRINT 933,N,K,IP,M,FF,T,E,TAU
4140        IBKA=2
4150        NTILDA=N
4160C THIS WILL PRINT THE Y,Y HAT, DELTA Y
4170        ITCT=ITCT-1
4180        IWS(3)=1
4190        GØ TØ 61
4200  704   IF (IFP.LE.0) GØ TØ 703
4210        IBKA=3
4220        IFP=0
4230        GØ TØ 61
4240  703   IF (NCØNS.EQ.0) GØ TØ 706
4250 PRINT 938,(JJ,CØNS(JJ),JJ=1,NCØNS)
```

```
4260   706 WS=N-K+IP
4270       SE=SQRT(PHI/WS)
4280       PHIZ=PHI
4290       IF(IWS(2).EQ.0) GØ TØ 709
4300 PRINT 903,PHIZ,SE,XL
4310       GO TØ 708
4320 709 PRINT 909,PHIZ,SE,XL
4330C NØW WE HAVE MATRIX A
4340 708   DØ 1123 II=1,K
4350       III=II+K
4360       DØ 1123 JJ=1,K
4370  1123 A(III,JJ)=A(II,JJ)
4380       IBKM=2
4390       GØ TØ 404
4400C NØW WE HAVE C = A INVERSE
4410   710 DØ 711 J=1,K
4420       IF(A(J,J).LT..0) GØ TØ 713
4430  711  SA(J)=SQRT(A(J,J))
4440       GØ TØ 715
4450   713 IBØUT=1
4460   715 KST=-4
4470 PRINT 916
4480   234 KST=KST+5
4490       KEND=KST+4
4500       IF (KEND.LT.K) GØ TØ 719
4510       KEND=K
4520   719 DØ 712 I=1,K
4530 712 PRINT 918,I,(A(I,J),J=KST,KEND)
4540       IF (KEND.LT.K) GØ TØ 234
4550       IF (IBØUT.EQ.0) GØ TØ 717
```

```
PRINT 936
      GO TO 10
  717 DO 718 I=1,K
      DO 718 J=1,K
      WS=SA(I)*SA(J)
      IF(WS.GT. 0.) GOTO 716
      A(I,J)=0.
      GO TO 718
  716 A(I,J)=A(I,J)/WS
  718 CONTINUE
      DO 720 J=1,K
  720 A(J,J)=1.
PRINT 917
      KST=-9
  721 KST=KST+10
      KEND=KST+9
      IF (KEND.LT.K) GO TO 722
      KEND=K
  722 DO 724 I=1,K
724 PRINT 935,I,(A(I,J),J=KST,KEND)
      IF (KEND.LT.K) GO TO 721
C GET T*SE*SQRT(C(I,I))
      DO 726 J=1,K
  726 SA(J)=  SE*SA(J)
      DO 1113 II=1,K
      III=II+K
      DO 1113 JJ=1,K
 1113 A(II,JJ)=A(III,JJ)
PRINT 919
      WS=K-IP
```

```
      DØ 750 J=1,K
      IF (IP.LE.0)GØ TØ 743
      DØ 742 I=1,IP
      IF (J.EQ.IB(I))GØ TØ 746
  742 CONTINUE
 743  HJTD=SQRT(WS*FF)*SA(J)
      STE=SA(J)
      ØPL=BS(J)-SA(J)*T
      ØPU=BS(J)+SA(J)*T
      SPL=BS(J)-HJTD
      SPU=BS(J)+HJTD
PRINT 927,J,STE,ØPL,SPL,ØPU,SPU
      GØ TØ 750
746 PRINT 913,J
C NØNLINEAR CØNFIDENCE LIMIT
750   IF(IWS(6).EQ.1) GØ TØ 10
      WS=K-IP
      WS1=N-K+IP
      PKN=WS/WS1
      PC=PHIZ*(1.+FF*PKN)
PRINT 920,PC
PRINT 921
      IWS(3)=1
      DØ 790 J=1,K
      IBKP=1
      DØ 752 JJ=1,K
  752 B(JJ)=BS(JJ)
      IF (IP.LE.0)GØ TØ 758
      DØ 756 JJ=1,IP
      IF (J.EQ.IB(JJ))GØ TØ 787
```

```
756 CONTINUE
758 DD=-1.
    IBKN=1
760 D=DD
    B(J)=BS(J)+D*SA(J)
    IBK2=4
    GØ TØ 300
762 PHI1=PHI
    IF (PHI1.GE.PC)GØ TØ 770
764 D=D+DD
    IF (D/DD.GE.5.)GØ TØ 788
    B(J)=BS(J)+D*SA(J)
    IBK2=5
    GØ TØ 300
766 PHID=PHI
    IF (PHID.LT.PC)GØ TØ 764
    IF (PHID.GE.PC) GØ TØ 778
770 D=D/2.
    IF (D/DD.LE..001)GØ TØ 788
    B(J)=BS(J)+D*SA(J)
    IBK2=6
    GØ TØ 300
772 PHID=PHI
    IF (PHID.GT.PC)GØ TØ 770
778 XK1=PHIZ/D+PHI1/(1.-D)+PHID/(D*(D-1.))
    XK2=-(PHIZ*(1.+D)/D+D/(1.-D)*PHI1+PHID/(D*(D-1.)))
    XK3=PHIZ-PC
    BC = (SQRT(XK2*XK2-4.*XK1*XK3)-XK2)/(2.*XK1)
    GØ TØ (779,784),IBKN
779 B(J)=BS(J)-SA(J)*BC
```

```
      GØ TØ 781
  784 B(J)=BS(J)+SA(J)*BC
  781 IBK2=2
      GØ TØ 300
  780 GØ TØ (782,786),IBKN
  782 IBKN=2
      DD=1.
      BL=B(J)
      PL=PHI
      GØ TØ 760
  786 BU=B(J)
      PU=PHI
      GØ TØ (783,795,785,789),IBKP
783 PRINT 940,J,BL,BU,PL,PU
      GØ TØ 790
795 PRINT 915,J,BU,PU
      GØ TØ 790
785 PRINT 941,J,BL,PL
      GØ TØ 790
787 PRINT 913,J
      GØ TØ 790
789 PRINT 914,J
      GØ TØ 790
  788 GØ TØ (791,792),IBKN
C DELETE LØWER PRINT
  791 IBKP=2
      GØ TØ 780
  792 GØ TØ (793,794),IBKP
C DELETE UPPER PRINT
  793 IBKP=3
```

```
           GØ TØ 780
C LØWER IS ALREADY DELETED, SØ DELETE BØTH
      794 IBKP=4
           GØ TØ 780
      790 CONTINUE
           GØ TØ 10
 900 FØRMAT(1X,"N,K,IP,M,IFP,NCØNS")
 901 FØRMAT(1X,"IWS(I),I=1,6")
 903 FØRMAT(/24H ESTIMATED PARTIALS USED /13X,4H PHI 14X,
 &4H S E 9X,7H LAMBDA /5X,2E18.8,E13.3)
 904 FØRMAT(/12H INCREMENTS /4(/1X,4E18.8))
   905 FØRMAT (13X,4H PHI 10X,7H LAMBDA 6X,7H GAMMA  6X, 7H LENGTH /
 & 5X, E18.8, 3E13.3)
 906 FØRMAT(1X,1E9.2,36X,E9.2/1X,1H+ 49X,1H+)
 907 FØRMAT(5H- N= I3,5X,5H K = I3,5X,5H IP= I3,5X,5H M = I3,5X,
 & 7H IFP = I3/5X,13HGAMMA CRIT = E10.3,5X,6HDEL = E10.3,6H FF =
 & E10.3/5X,5H T = E10.3,5X,5H E = E10.3,5X,7H TAU = E10.3/5X,6H XL=
 &  E10.3 , 4X, 7HZETA = E10.3 /)
 908 FØRMAT(/2H (I3,13H) PARAMETERS 3E18.8,3(/18X,3E18.8))
 909 FØRMAT(/24H ANALYTIC PARTIALS USED /13X,4H PHI 14X,
 &4H S E 9X,7H LAMBDA /5X,2E18.8,E13.3)
   910 FØRMAT(1H /5X,9X,4H OBS 13X,5H PRED 13X,5H DIFF  )
 911 FØRMAT(/24H ESTIMATED PARTIALS USED /9X,4H PHI 12X,4H S E
 &9X,7H LENGTH 4X,7H GAMMA 4X,7H LAMBDA /1X,2E16.8,3E11.3)
 912 FØRMAT(/24H ANALYTIC PARTIALS USED /9X,4H PHI 12X,4H S E
 &9X,7H LENGTH 4X,7H GAMMA 4X,7H LAMBDA/5X,2E16.8,3E11.3)
   913 FØRMAT(2X,I3,20H PARAMETER NØT USED   )
   914 FØRMAT(2X,I3,12H NØNE FØUND   )
 915 FØRMAT(2X,I3,18X,E18.8/23X,E18.8)
   916 FØRMAT(1H /13H PTP INVERSE )
```

```
  917 FØRMAT(1H /30H PARAMETER CØRRELATIØN MATRIX  )
918 FØRMAT(2X,I3,6E12.5/ 2(6X,6E10.5))
919 FØRMAT(1H /1H /13X,4H STD,11X,13HONE-PARAMATER 6X,14H
&SUPPØRT PLANE /3X,2H B 7X,6H ERRØR 9X,14H LØWER / UPPER
&6X,14H LØWER / UPPER)
920   FØRMAT(1H /1H /30H  NONLINEAR CØNFIDENCE LIMITS  / /
& 16H PHI CRITICAL = E15.8)
921 FØRMAT(1H /5H PARA 19H LØWER B / LØWER PHI 19H UPPER
&B / UPPER PHI )
922 FØRMAT(1H-/20X,17HGAMMA LAMBDA TEST 6X,2E13.3)
923 FØRMAT (1H-/60X,12HEPSILØN TEST )
924 FØRMAT(1H-/60X,10HFØRCE OFF  )
925 FØRMAT(5X,3E18.8/ 2(10X,3E18.8))
  926 FØRMAT ( 40H BAD DATA, SUBSCRIPTS FØR UNUSED BS = 0   / / / )
927 FØRMAT(2X,I3,3E18.8/23X,2E18.8)
928 FØRMAT(1H 70A1)
929 FØRMAT(1X,"YMN,SPRD")
930 FØRMAT(1X,"IB(I),I=1,",I3)
931 FØRMAT(1X,"FF,T,E,TAU,XL,GAMCR,DEL,ZETA")
932 FØRMAT(1X,"B(I),I=1,",I3)
933   FØRMAT(5HON = I3,5X,5H K = ,I3,5X,5H IP= ,I3,5X,5H M = ,I3,5X
& /6H FF = ,E10.3,4X,5H T = ,E10.3,
& 4X,5H E = ,E10.3,4X,7H TAU = ,E10.3/)
934 FØRMAT(1H-/55X,18HGAMMA EPSILØN TEST )
935 FØRMAT(3X,I5,2X,6F10.4/2(11X,6F10.4))
  936 FØRMAT (27H0 NEGATIVE DIAGØNAL ELEMENT   )
937 FØRMAT(3X,I5,2X,6F10.4/ 2(11X,6F10.4))
```

```
6330 938 FØRMAT(1H /25H CØNSTRAINT RESIDUALS ... /12(3X,I5,33X,E18.8))
6340  939  FØRMAT (1H /23H PTP CØRRELATIØN MATRIX )
6350 940 FØRMAT(2X,I3,2E18.8/5X,2E18.8)
6360 941 FØRMAT(2X,I3,E18.8/5X,E18.8)
6370 942 FØRMAT(1X,"Y(I),(X(I,L)L=1,",I3,")")
6380 660    STØP
6390        END
6400        SUBRØUTINE GJR(N,EPS,MSING)
6410C GAUSS-JØRDAN-RUTISHAUSER MATRIX INVERSIØN WITH DØUBLE PIVØTING
6420C K,N,M AS DEFINED IN MAIN PRØGRAM
6430C DIMENSIØN PRNT(5),X(N,M),B(K),Y(N),A(2K,K),P(K)
6440C DIMENSIØN C(K),Q(K),BDUM(K)
6450        DIMENSIØN PRNT(5)
6460        DIMENSIØN X(25,1),B(12),Y(25),A(24,12),P(12)
6470        DIMENSIØN C(12),Q(12),BDUM(12)
6480 CØMMØN X,BDUM,PRNT,A,DUMM(12)
6490 CØMMØN Y
6500 CØMPLEX Y
6510        MSING=1
6520        DØ 10 K=1,N
6530C DETERMINATIØN ØF THE PIVØT ELEMENT
6540        PIVØT=0.
6550        DØ 20 I=K,N
6560        DØ 20 J=K,N
6570        IF((ABS(A(I,J))-ABS(PIVØT)).LE.0.) GØ TØ 20
6580        PIVØT=A(I,J)
6590        P(K)=I
6600        Q(K)=J
6610     20 CØNTINUE
6620        IF((ABS(PIVØT)-EPS).LE.0.) GØ TØ 40
```

```
C EXCHANGE ØF THE PIVØTAL RØW WITH THE K TH RØW
      IF((P(K)-K).EQ.0) GØ TØ 80
      DØ 70 J=1,N
      L=P(K)
      Z=A(L,J)
      A(L,J)=A(K,J)
   70 A(K,J)=Z
C EXCHANGE ØF THE PIVØTAL CØLUMN WITH THE K TH CØLUMN
   80 IF((Q(K)-K).EQ.0) GØ TØ 90
      DØ 100 I=1,N
      L=Q(K)
      Z=A(I,L)
      A(I,L)=A(I,K)
  100 A(I,K)=Z
   90 CØNTINUE
C JØRDAN STEP
      DØ 110 J=1,N
      IF((J-K).NE.0) GØ TØ 130
      B(J)=1./PIVØT
      C(J)=1.
      GØ TØ 140
  130 B(J)=-A(K,J)/PIVØT
      C(J)=A(J,K)
  140 A(K,J)=0.
  110 A(J,K)=0.
      DØ 10 I=1,N
      DØ 10 J=1,N
   10 A(I,J)=A(I,J)+C(I)*B(J)
C REØRDERING THE MATRIX
      DØ 155 M=1,N
```

```
      K=N-M+1
      IF((P(K)-K).EQ.0)  GØ TØ 170
      DØ 180 I=1,N
      L=P(K)
      Z=A(I,L)
      A(I,L)=A(I,K)
  180 A(I,K)=Z
170   IF((Q(K)-K).EQ.0)  GØ TØ 155
      DØ 150 J=1,N
      L=Q(K)
      Z=A(L,J)
      A(L,J)=A(K,J)
  150 A(K,J)=Z
 155  CONTINUE
  151 RETURN
40 PRINT 45,P(K),Q(K),PIVØT
   45 FØRMAT(16HOSINGULAR MATRIX3H I=I3,3H J=I3,7H PIVØT=E16.8/)
      MSING=2
      GØ TØ 151
      END
      SUBRØUTINE SUBZ(NPRNT,N)
C CØDING INITIALIZATIØN
C K,N,M AS DEFINED IN MAIN PRØGRAM
C DIMENSIØN PRNT(5),X(N,M),B(K),Y(N)
      DIMENSIØN PRNT(5)
      DIMENSIØN X(25,1),B(12),Y(25)
      DIMENSIØN C(19)
COMMØN X,B,PRNT,A(24,12),P(12)
COMMØN Y
CØMPLEX Y
```

```
7230 INPUT 1,C
7240 PRINT 1,C
7250 1      FØRMAT(1X,19A4)
7260        RETURN
7270        END
7280        SUBRØUTINE FCØDE(F,I,RES)
7290C CØDING FØR FUNCTIØN AND RESIDUES
7300C K,N,M AS DEFINED IN MAIN PRØGRAM
7310C DIMENSIØN PRNT(5),X(N,M),B(K),Y(N)
7320C CØDING FØR PLUG FLØW REACTØR
7330        DIMENSIØN PRNT(5)
7340        DIMENSIØN X(25,1),B(12),Y(25)
7350 CØMMØN X,B,PRNT,A(24,12),P(12)
7360 CØMMØN Y
7370 CØMPLEX Y
7380 CØMPLEX TEM,CS
7390        ØM=X(I,1)
7400        Y1=B(3)/(1.+(B(4)/ØM)**2)
7410        Y2=(B(4)/ØM)*Y1
7420 Z=-(B(1)*B(2)*Y1)
7430        D=-(B(1)*((1.-B(2))*ØM+B(2)*Y2))
7440 TEM=CMPLX(Z,D)
7450 E=EXP(Z)
7460 F=CØS(D)
7470 H=SIN(D)
7480 TEMP=E*F
7490 REM=E*H
7500 CS=CMPLX(TEMP,REM)
7510        TEM=Y(I)-CS
7520        RES=CABS(TEM)
7530        F=CABS(CS)
```

```
7540         RETURN
7550         END
7560         SUBRØUTINE PCØDE(F,I)
7570C CØDING FØR PARTIAL ØF F WITH RESPECT TØ B S
7580C K,N,M AS DEFINED IN MAIN PRØGRAM
7590C DIMENSIØN PRNT(5),X(N,M),B(K),Y(N),A(2K,K),P(K)
7600         DIMENSIØN PRNT(5)
7610         DIMENSIØN X(25,1),B(12),Y(25),A(24,12),P(12)
7620 CØMMØN X,B,PRNT,A,P
7630 CØMMØN Y
7640 CØMPLEX Y
7650         RETURN
7660         END
```

INPUT ITEMS FOR NLIN1

INPUT ITEM NO.	FORTRAN LABEL	COMMENTS
1	N	No. of data points.
	K	Total No. of parameters.
	IP	No. of omitted parameters.
	M	No. of independent variables.
	IFP	IFP = 0 to tabulate Y_i, Y_i, $(Y_i - Y_i)$, PRNT(1)...PRNT(5) IFP = 1 to plot Y_i, Y_i.
	NCONS	No. of constraints.
2	IWS(1)	Doesn't apply.
	IWS(2)	= 0 Analytical derivatives. = 1 Estimated derivatives.
	IWS(3)	= 0 Abbreviated printout. = # Detail printout for # iterations
	IWS(4)	= 0 No force off. = # Forced branch to confidence region calculation after # iterations.
	IWS(5)	Doesn't apply.
	IWS(6)	= 0 Nonlinear confidence limits desired.
3	YMN	Left side of plot.
	SPRD	Spread of plot.

(Item 3 is required only if IFP = 1.)

4	IB(1) : IB(IP)	Subscripts of omitted B(J)'S.

INPUT ITEMS FOR NLIN1 CONT.

INPUT ITEM NO.	FORTRAN LABEL	COMMENTS

(Item 4 is required only if IP 0.)

5	FF	Variance ratio statistic.
	T	Student's T.
	E	Convergence criterion.
	TAV	Convergence criterion.
	XL	Program parameter.
	GAMCR	Critical angle.
	DEL	Used in finite difference derivatives.
	ZETA	Singularity criterion for matrix inversion.

Any or all of the quantities may be left zero. If this is done, the program supplies the following reasonable values for most situations.

FF = 4.0, T = 2.0, E = 5×10^{-5}, TAV = 10^{-3}, XL = 10^{-2}, GAMCR = $\pi/4$, DEL = 10^{-5}, ZETA = 10^{-31}

6	B(1) ⋮ B(K)	Initial guess for parameters.

7 This item consists of N sub-items. Each sub-item is the input data for one observation. The sequence of variables in a sub-item must be:

Y(I), X(I,1), X(I,2), ...X(I,M). Each Y(I) begins on a new line.

8 Case data from subroutine SUB Z. In this case, a comment line is required.

9 Sequential cases by repeating items 1 through 8. For normal exit type item 1 with all zeroes.

```
MØD            12:32       04/07/70

100 CØMPLEX CFP,CFB,CYP,CGAMP,CGAMB,CBETA,CTP,S,SS,CTVP,CTVB,
110 &CEL,CEN,TEM,CS,HS,NUMB,NUMP,DEN,DEN1,DEN2,CYB,CEPP,CEPB,CE
120 &P,CEB,CBY,CPBY
130 REAL ZERØ,ØMEGA,ZS,ZT,U,UØ,VP,K,GAMP,GAMB,VB,UB,UP,BETA,TP,
140 &ØM,Z,TVP,TVB,EL,EN,R,XMAG,AMAG,DUM,ANG,K1,K2,Y1,Y2,ZØ,
150 &EPP,EPB,EP,EB
160 DIMENSIØN ØMEGA(100),ZS(18)
170 ZERØ=0.0
180C NØ. ØF VALUES ØF ØMEGA
190 INPUT,NIT
200 INPUT,(ØMEGA(I),I=1,NIT)
210C NØ. ØF STAGES.  IF ZERØ, PRØGRAM EXITS
220 2 INPUT,NIT
230 IF(NIT.LE.0) GØ TØ 3
240C HEIGHT ØF STAGES
250 INPUT,(ZS(I),I=1,NIT)
260 ZT=0.0
270 DØ 10 I=1,NIT
280 10 ZT=ZT+ZS(I)
290 95 FØRMAT(1H 1X,3(/1X,4G15.3))
300C INPUT PARAMETERS
```

```
310 INPUT,U,U0,VP,K,GAMB,GAMP,K1,K2,Z0,EP,EB,VBY
320 VB=1.0-VP-VBY
330 UP=U0
340 UBY =ZT*(U-UP)/(ZT-Z0)+UP
350 BPT=ZT/UBY
360 UB=(U-VP*UP-VBY*UBY)/VB
370C IF UB.LT.UP DEAD Z0NE EXISTS
380 IF(UB.GE.UP)G0 T0 11
390 UB=UP
400 DUM=VP
410 VP=(U-VBY*UBY-VB*UB)/UP
420 DUM=DUM-VP
430 PRINT,VP,DUM
440 GAMB=GAMP
450 G0 T0 12
460 11 GAMB=(GAMP/VB)*(Z0/ZT-VP)
470 12 BETA=VP*UP/U
480 TP=VP/K
490 IF(GAMB.GT.0.) G0 T0 9
500 GAMB=0.
510 9 PRINT 95,(ZS(I),I=1,NIT),ZT
520 PRINT 93,U,U0,VP,K,GAMB,GAMP,K1,K2,Z0,UB,EP,EB,UBY
530 93 F0RMAT(4(/1X,4G15.3))
540 PRINT 91
550 91 F0RMAT(//8X,"FREQUENCY",6X,"MAGNITUDE",8X,"ANGLE")
560 CEP=CMPLX(EP,ZER0)
```

```
570 CEB=CMPLX(EB,ZERØ)
580 CGAMB=CMPLX(GAMB,ZERØ)
590 CGAMP=CMPLX(GAMP,ZERØ)
600 CBETA=CMPLX(BETA,ZERØ)
610 CBY=CMPLX((VBY*UBY/U),ZERØ)
620 CTP=CMPLX(TP,ZERØ)
630 IT=1
640 1 ØM=ØMEGA(IT)
650 IF(ØM.LE.0.) GØ TØ 2
660C CALCULATE ADMITTANCE
670 Y1=(K1/(1.0+(K2/ØM)**2))
680 Y2=(K1*(K2/ØM))/(1.0+(K2/ØM)**2)
690 CYP=CMPLX(Y1,Y2)
700 CYB=CYP
710 CYP=CYP*CEP
720 CYB=CYB*CEB
730 S=CMPLX(ZERØ,ØM)
740 SS=((1.0,0.0)-CGAMP)*S+CGAMP*CYP
750 CFP=(1.0,0.0)
760 CFB=(1.0,0.0)
770 DØ 6 I=1,NIT
780 Z=ZS(I)
790 TVP=VP*Z/U
800 TVB=VB*Z/U
```

```
EL=Z/UP
EN=EL/TP
CTVP=CMPLX(TVP,ZERØ)
CTVB=CMPLX(TVB,ZERØ)
CEL=CMPLX(EL,ZERØ)
CEN=CMPLX(EN,ZERØ)
TEM=-CEN-CEL*SS
E=EXP(REAL(TEM))
F=CØS(AIMAG(TEM))
H=SIN(AIMAG(TEM))
F=E*F
H=E*H
HS=CMPLX(F,H)
NUMB=CFB*((1.0,0.0)-CBETA-CBY)+CFP*CBETA*((1.0,0.0)-HS)
&/(CTP*SS+(1.0,0.0))
NUMP=((1.0,0.0)-HS)*NUMB/(CTP*SS+(1.0,0.0))
DEN=(((1.0,0.0)-CGAMB)*CTVB*S)+CTVP*SS/(CTP*SS+(1.0,0.0))
DEN1=CBETA*(CTP*SS+(2.0,0.0))*CTP*SS/((CTP*SS+(1.0,0.0))**2)
DEN2=CTVB*CGAMB*CYB-CBETA*HS/((CTP*SS+(1.0,0.0))**2)
DEN=DEN+DEN2-DEN1+(1.0,0.0)-CBY
CFB=NUMB/DEN
6 CFP=NUMP/DEN+CFP*HS
CBPY=CEXP(CMPLX(ZERØ,(-ØM*BPT)))
C PREDICTED TRANSFER FUNCTION
CS=((1.0,0.0)-CBETA-CBY)*CFB+CBETA*CFP+CBY*CBPY
```

```
1060C CØNVERT TRANSFER FUNCTIØN TØ MAGNITUDE RATIØ & PHASE ANGLE
1070 R=REAL(CS)
1080 XMAG=AIMAG(CS)
1090 AMAG=SQRT(R**2+XMAG**2)
1100 DUM=XMAG/R
1110 IF(DUM.LT.1.0E+36) GØ TØ 4
1120 ANG=ATAN(R/XMAG)*(180./3.14159)
1130 IF(R.LT.0.) ANG=ANG-90.
1140 GØ TØ 5
1150 4 ANG=ATAN(DUM)*(180./3.14159)
1160 IF(R.LT.0.) ANG=ANG-180.
1170 5 IF(ANG.LE.0.) GØ TØ 7
1180 ANG=ANG-360.
1190 7 PRINT 92,ØM,AMAG,ANG
1200 92 FØRMAT(1X,3G15.3)
1210 IT=IT+1
1220 GØ TØ 1
1230 3 CØNTINUE
1240 STØP
1250 END
```

APPENDIX IV

CALCULATIONS

TABLE III

PHASE ANGLE SHIFT FROM CALCULATED LAG TIMES

Flow Rate, ft./sec.	0.264	0.309	0.399
Lag Time, secs.	0.5	0.275	0.286
Frequency, rad./sec.			
0.1	2.86	1.57	1.64
0.2	5.72	3.14	3.28
0.3	8.58	4.71	4.92
0.4	11.4	6.28	6.56
0.5	14.3	7.85	8.20
0.6	17.2	9.42	9.84
0.7	20.0	11.0	11.5
0.8	22.8	12.6	13.1
0.9	25.7	14.1	14.8
1.0	28.6	15.7	16.4
2.0	57.2	31.4	32.8
3.0	85.8	47.1	49.2
4.0	114.	62.8	65.6
5.0	143.	78.5	82.0
6.0	172.	94.2	98.4
7.0	200.	110.	115.
8.0	228.	126.	131.
9.0	257.	141.	148.
10.	286.	157.	164.

APPENDIX V

COMPUTED DATA

```
NLIN1          16:45        03/13/70

N,K,IP,M,IFP,NCONS?17,4,2,1,1,0

IWS(I),I=1,6?0,1,2,20,0,0

YMN,SPRD?-2.0,2.0

IB(I),I=1,   2?1,2

FF,T,E,TAU,XL,GAMCR,DEL,ZETA?0,0,0,0,0,0,0,0

B(I),I=1,   4?5.14,0.542,88.5,4.52.35,0.693,120.,4.0

.-IS BAD CHAR IN DATA OR BAD FORMAT.

RETYP DATA FOR LIST IN LINE  235
?5.14,0.542,88.5,4.5
Y(I),(X(I,L)L=1,   1)?.7746,-.6324,0.02

?.5630,-.8144,0.03

?.2460,-.9486,0.04
```

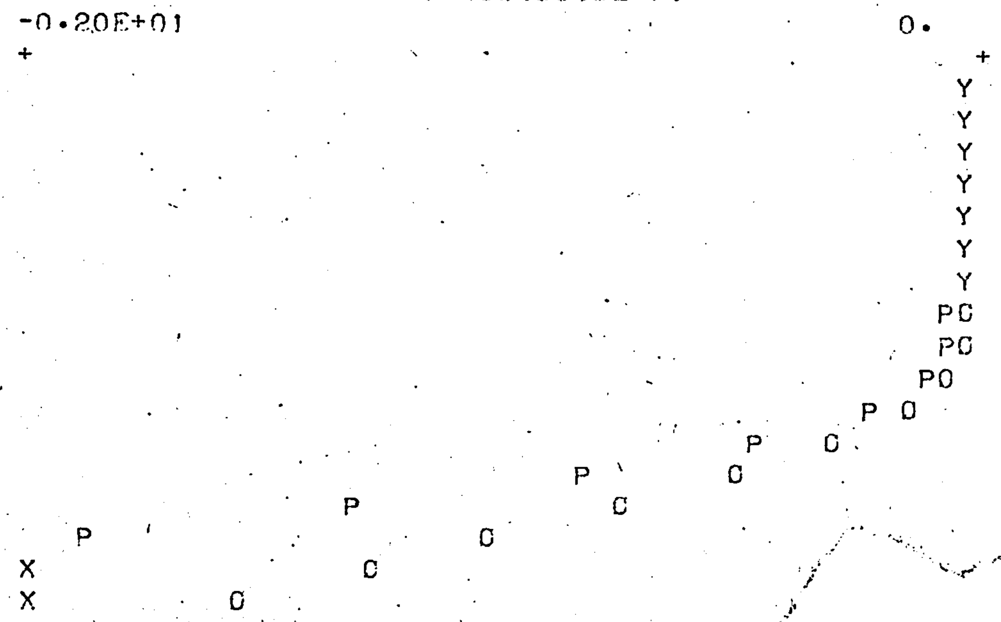
```
?-.07779,-.9669,0.05
?-.3705,-.8856,0.06
?-.6610,-.6893,0.07
?-.8301,-.4620,0.08
?-.9284,-.1470,0.09
?-.9232,.1479,0.1
?.2327,.8279,0.15
?.7026,-.2324,0.2
?-.4585,.1994,0.3
?.2869,-.1630,0.4
?-.1546,0.0922,0.5
?.0918,-.0371,0.60
?-.0533,.0173,0.7
?.0299,-.0021,0.8
?   F-12 PLUG FLOW REACTOR AIR RATE 2.0 CM
```

RECOMM GE RECOMM G

```
F-12 PLUG FLOW REACTOR AIR RATE 2.0 CM

N=  17      K =    4       IP=    2        M =    1        IFP =    1
    GAMMA CRIT =  0.450E+02      DEL =  0.100E-04 FF =  0.400E+01
     T =  0.200E+01       E =  0.500E-04       TAU =  0.100E-02
     XL =  0.              ZETA =  0.100E-30

(   0) PARAMETERS      0.51400000E+01    0.54200000E+00    0.88500000E+02
                       0.45000000E+01
```



```
PTP CORRELATION MATRIX
        1       1.0000      0.          0.          0.
        2       0.          1.0000      0.          0.
        3       0.          0.          1.0000     -0.9991
        4       0.          0.         -0.9991      1.0000

ESTIMATED PARTIALS USED
              PHI                  S E              LAMBDA
        0.18072655E+02     0.10976537E+01       0.100E-01

INCREMENTS

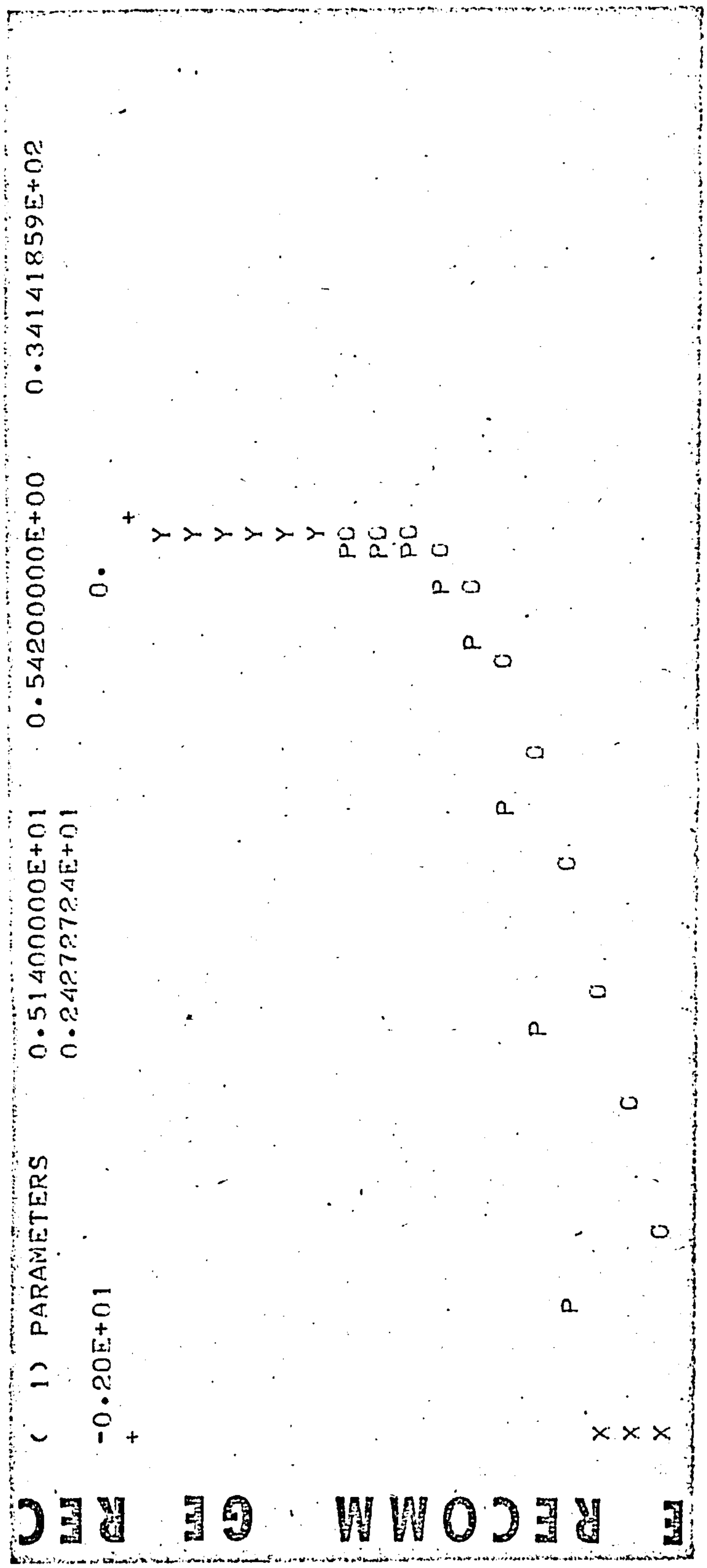
    0.                 0.                   -0.54358141E+02   -0.20727276E+01

              PHI             LAMBDA          GAMMA          LENGTH
        0.46963375E+01     0.100E-01      0.797E+02      0.767E+01

INCREMENTS

    0.                 0.                   -0.27628154E+03   -0.13338961E+02

              PHI             LAMBDA          GAMMA          LENGTH
        0.57854232E+04     0.100E-02      0.864E+02      0.430E+02
```


(1) PARAMETERS
-0.20E+01
0.51400000E+01
0.24272724E+01
0.54200000E+00
0.34141859E+02

```
PTP CORRELATION MATRIX
         1      1.0000      0.          0.          0.
         2      0.          1.0000      0.          0.
         3,     0.          0.          1.0000     -0.9986
         4      0.          0.         -0.9986      1.0000

ESTIMATED PARTIALS USED
             PHI                   S E              LAMBDA
        0.46963375E+01      0.55954371E+00      0.100E-01

INCREMENTS

   0.                  0.                  -0.11606948E+02    -0.23566788E+00

             PHI               LAMBDA          GAMMA          LENGTH
        0.59232109E+00      0.100E-01      0.599E+02      0.287E+01

INCREMENTS

   0.                  0.                  -0.39073251E+02    -0.22453842E+01

             PHI               LAMBDA          GAMMA          LENGTH
        0.50038820E+12      0.100E-02      0.825E+02      0.118E+02
```

```
(  2) PARAMETERS      0.51400000E+01    0.54200000E+00    0.22534910E+02
                      0.21916045E+01

ESTIMATED PARTIALS USED
         PHI              S E          LENGTH     GAMMA      LAMBDA
  0.59232109E+00  0.19871606E+00  0.118E+02  0.825E+02  0.100E-01

(  3) PARAMETERS      0.51400000E+01    0.54200000E+00    0.29744771E+02
                      0.26921962E+01

ESTIMATED PARTIALS USED
         PHI              S E          LENGTH     GAMMA      LAMBDA
  0.94736129E-01  0.79471642E-01  0.288E+01  0.796E+02  0.100E-02

(  4) PARAMETERS      0.51400000E+01    0.54200000E+00    0.43354798E+02
                      0.39347743E+01

ESTIMATED PARTIALS USED
         PHI              S E          LENGTH     GAMMA      LAMBDA
  0.98543253E-02  0.25631134E-01  0.243E+01  0.480E+02  0.100E-03

(  5) PARAMETERS      0.51400000E+01    0.54200000E+00    0.49387179E+02
                      0.44855003E+01

ESTIMATED PARTIALS USED
         PHI              S E          LENGTH     GAMMA      LAMBDA
  0.84017115E-02  0.23666730E-01  0.151E+01  0.522E+02  0.100E-04
```

```
(  6) PARAMETERS      0.51400000E+01      0.54200000E+00      0.46860297E+02
                      0.42508466E+01

ESTIMATED PARTIALS USED
          PHI                S E             LENGTH      GAMMA       LAMBDA
  0.72411139E-02   0.21971366E-01   0.543E+00   0.324E+02   0.100E-03

(  7) PARAMETERS      0.51400000E+01      0.54200000E+00      0.46620405E+02
                      0.42335565E+01

ESTIMATED PARTIALS USED
          PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71266487E-02   0.21797016E-01   0.106E+00   0.836E+02   0.100E-03

(  8) PARAMETERS      0.51400000E+01      0.54200000E+00      0.46912470E+02
                      0.42594095E+01

ESTIMATED PARTIALS USED
          PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71184443E-02   0.21784466E-01   0.656E-01   0.791E+02   0.100E-04

(  9) PARAMETERS      0.51400000E+01      0.54200000E+00      0.46901383E+02
                      0.42596260E+01

ESTIMATED PARTIALS USED
          PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71180564E-02   0.21783872E-01   0.182E-02   0.309E+02   0.100E+00
```

```
( 10) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46871251E+02
                      0.42557070E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA        LAMBDA
  0.71173885E-02  0.21782850E-01  0.844E-02  0.777E+02  0.100E-01

( 11) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46860272E+02
                      0.42558232E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA        LAMBDA
  0.71171350E-02  0.21782462E-01  0.177E-02  0.361E+02  0.100E+00

( 12) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46844237E+02
                      0.42532812E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA        LAMBDA
  0.71170969E-02  0.21782404E-01  0.518E-02  0.732E+02  0.100E-01

( 13) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46834937E+02
                      0.42534834E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA        LAMBDA
  0.71169672E-02  0.21782206E-01  0.153E-02  0.297E+02  0.100E+00
```

```
( 14) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46839392E+02
                      0.42528853E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71168218E-02  0.21781983E-01  0.249E-02  0.578E+02  0.100E+00

( 15) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46832585E+02
                      0.42532173E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71166647E-02  0.21781743E-01  0.324E-02  0.666E+02  0.100E+00

( 16) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46837322E+02
                      0.42527422E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71165636E-02  0.21781588E-01  0.130E-02  0.246E+02  0.100E+00

( 17) PARAMETERS      0.51400000E+01     0.54200000E+00     0.46830974E+02
                      0.42530322E+01

ESTIMATED PARTIALS USED
        PHI                S E             LENGTH      GAMMA       LAMBDA
  0.71164643E-02  0.21781436E-01  0.322E-02  0.685E+02  0.100E+00
```

RECOMM GE RECOMM G

GE RECOMM GE

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( 18) PARAMETERS      0.51400000E+01    0.54200000E+00    0.46835880E+02
                      0.42526407E+01

ESTIMATED PARTIALS USED
        PHI                S E              LENGTH       GAMMA       LAMBDA
  0.71164123E-02  0.21781356E-01  0.120E-02  0.247E+02  0.100E+00

( 19) PARAMETERS      0.51400000E+01    0.54200000E+00    0.46831164E+02
                      0.42530302E+01

ESTIMATED PARTIALS USED
        PHI                S E              LENGTH       GAMMA       LAMBDA
  0.71163556E-02  0.21781270E-01  0.113E-02  0.182E+02  0.100E+00


                                                                  FORCE OFF

N =   17       K =    4       IP=    2       M =    1
FF =  0.400E+01      T =  0.200E+01    E =  0.500E-04   TAU =  0.100E-02
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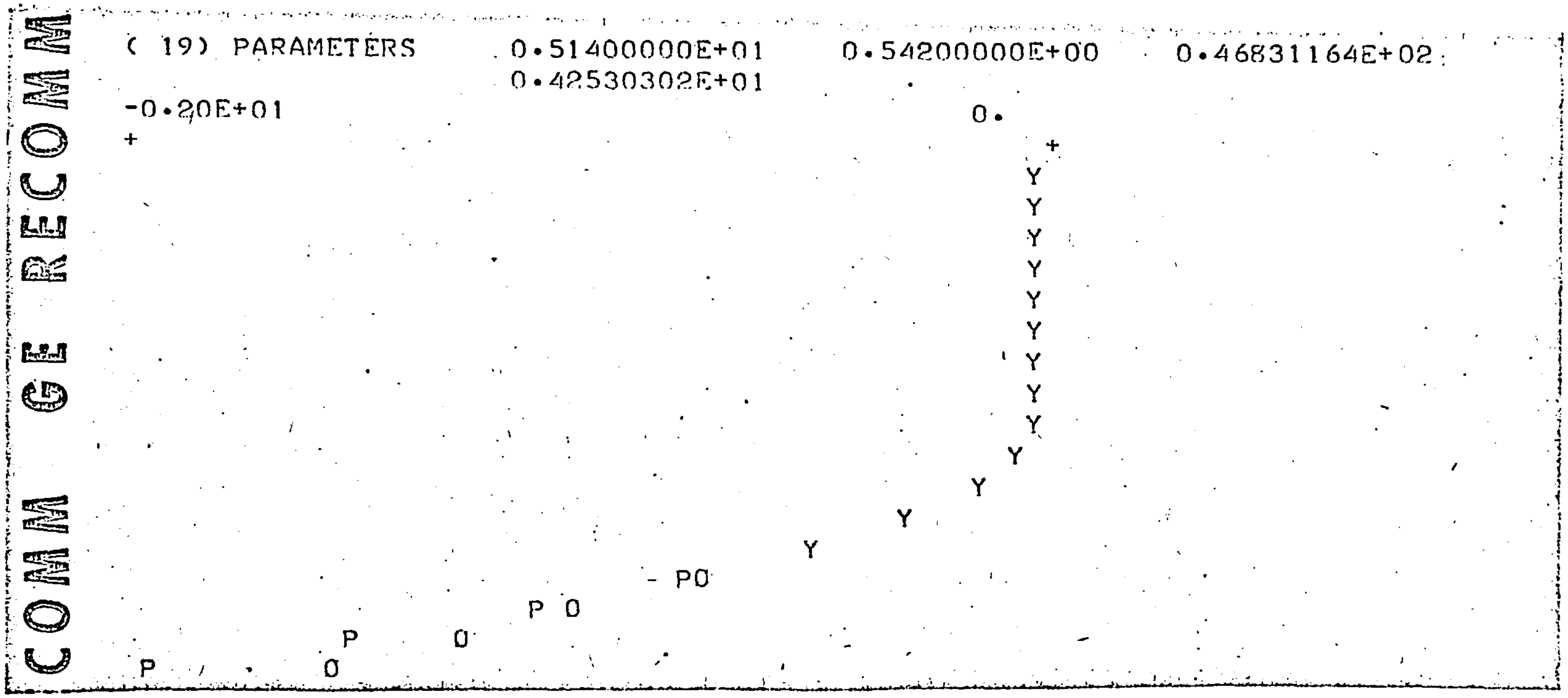
(19) PARAMETERS
0.51400000E+01
0.42530302E+01
0.54200000E+00
0.46831164E+02
-0.20E+01
COMM GE RECOMM

(19) PARAMETERS 0.51400000E+01 0.54200000E+00 0.46831164E+02
0.42530302E+01

OBS	PRED	DIFF
0.99996746E+00	0.99711911E+00	0.24217415E-01
0.99005876E+00	0.99352987E+00	0.24966590E-01
0.97997855E+00	0.98852695E+00	0.94281074E-02
0.97002417E+00	0.98213218E+00	0.12109891E-01
0.95997792E+00	0.97437337E+00	0.20037580E-01
0.95501596E+00	0.96528404E+00	0.24974275E-01
0.95000526E+00	0.95490327E+00	0.89104907E-02
0.93996572E+00	0.94327533E+00	0.12756214E-01
0.93497200E+00	0.93044940E+00	0.45950972E-02
0.85998122E+00	0.85036884E+00	0.33549217E-01
0.74003819E+00	0.74985673E+00	0.12387649E-01
0.49998261E+00	0.52417330E+00	0.28243298E-01
0.32997062E+00	0.31856771E+00	0.13352899E-01

0.18000555E+00	0.16887384E+00	0.15304816E-01
0.99013382E-01	0.78401092E-01	0.28586544E-01
0.56037309E-01	0.32031723E-01	0.26222884E-01
0.29973655E-01	0.11580791E-01	0.19710309E-01

ESTIMATED PARTIALS USED

PHI	S E	LAMBDA
0.71163556E-02	0.21781270E-01	0.100E+00

PTP INVERSE

1	0.10000E+01	0.	0.	0.
2	0.	0.10000E+01	0.	0.
3	0.	0.	0.97486E+04	0.87027E+03
4	0.	0.	0.87027E+03	0.78007E+02

PARAMETER CORRELATION MATRIX

1	1.0000	0.	0.	0.
2	0.	1.0000	0.	0.
3	0.	0.	1.0000	0.9980
4	0.	0.	0.9980	1.0000

```
                 STD              ONE-PARAMATER        SUPPORT PLANE
   B            ERROR             LOWER / UPPER        LOWER / UPPER
   1 PARAMETER NOT USED
   2 PARAMETER NOT USED
   3      0.21505771E+01      0.42530010E+02      0.40748413E+02
                              0.51132318E+02      0.52913915E+02
   4      0.19237581E+00      0.38682786E+01      0.37089092E+01
                              0.46377818E+01      0.47971511E+01


  NONLINEAR CONFIDENCE LIMITS

 PHI CRITICAL =  0.10911745E-01

 PARA LOWER B / LOWER PHI   UPPER B / UPPER PHI
    1 PARAMETER NOT USED
    2 PARAMETER NOT USED
    3      0.46564399E+02     0.47103210E+02
           0.11046681E-01     0.10913450E-01
    4      0.42294363E+01     0.42773045E+01
           0.10573679E-01     0.10993118E-01
 N,K,IP,M,IFP,NCONS?0,0,0,0,0,0,


 PROGRAM STOP AT 2840
```

GE RECOMM GE RECOM

DPLS EY

TABLE IV

RUN ID H-01

COMMENTS HE TRACER BED IN AIR RATE 6.3 CM 12/27/68

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000 00	1.17	0.0000 00	84.0	0.0000 00	71.8	0.0000 00	1.00	71.8
0.1000-01	1.00	-0.320	0.999	-0.3900-01	0.999	-0.3340-01	1.00	71.8
0.2000-01	1.00	-0.642	0.996	-0.7790-01	0.996	-0.6670-01	0.998	71.7
0.3000-01	1.00	-0.967	0.990	-0.116	0.991	-0.9950-01	0.996	71.5
0.4000-01	1.00	-1.30	0.983	-0.154	0.984	-0.132	0.993	71.3
0.5000-01	1.00	-1.63	0.973	-0.192	0.975	-0.163	0.989	71.0
0.6000-01	1.00	-1.97	0.962	-0.228	0.965	-0.194	0.984	70.7
0.7000-01	1.01	-2.32	0.948	-0.264	0.953	-0.224	0.978	70.3
0.8000-01	1.01	-2.69	0.933	-0.298	0.939	-0.252	0.972	69.8
0.9000-01	1.01	-3.06	0.916	-0.331	0.924	-0.280	0.965	69.3
0.100	1.01	-3.44	0.898	-0.363	0.908	-0.305	0.958	68.8
0.200	1.03	-8.08	0.658	-0.600	0.712	-0.485	0.861	61.9
0.300	1.04	-13.9	0.394	-0.695	0.527	-0.557	0.767	55.1
0.400	1.03	-19.7	0.159	-0.696	0.372	-0.583	0.691	49.6
0.500	1.02	-25.3	-0.3430-01	-0.629	0.234	-0.573	0.619	44.5
0.600	0.992	-31.1	-0.168	-0.520	0.126	-0.536	0.551	39.6
0.700	0.956	-36.7	-0.245	-0.404	0.4690-01	-0.492	0.494	35.5
0.800	0.916	-41.9	-0.283	-0.296	-0.1440-01	-0.447	0.447	32.1
0.900	0.875	-47.1	-0.294	-0.199	-0.6200-01	-0.401	0.405	29.1
1.00	0.625	-51.8	-0.280	-0.117	-0.9830-01	-0.355	0.369	26.5
2.00	0.388	-62.1	-0.2940-01	0.4980-01	-0.138	-0.5760-01	0.149	10.7
3.00	0.223	-74.4	-0.1200-02	0.1470-01	-0.6490-01	0.1250-01	0.6610-01	4.75
4.00	0.257	-65.2	0.1480-02	0.7320-02	-0.2340-01	0.1720-01	0.2900-01	2.09
5.00	0.267	-83.8	0.1370-02	0.3050-02	-0.1060-01	0.8570-02	0.1360-01	0.979
6.00	0.149	-132.	0.1270-02	-0.1840-03	-0.4720-02	0.7160-02	0.8580-02	0.616
7.00	0.435	103.	-0.1230-02	-0.1280-02	-0.2240-02	0.3430-02	0.4090-02	0.294
8.00	0.546	12.8	-0.1100-02	0.1050-02	-0.1540-02	0.2370-02	0.2830-02	0.203
9.00	0.401	-54.3	0.2750-03	0.9500-03	-0.1520-02	0.1940-02	0.2460-02	0.177
10.0	0.410	-104.	0.7530-03	-0.4050-04	-0.3440-03	0.1810-02	0.1840-02	0.132

TABLE IV

RUN ID H-01

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.112	135.	-0.143D-03	-0.529D-04	0.578D-03	0.123D-02	0.136D-02	0.978D-01
21.0	0.262	72.3	0.948D-04	-0.251D-03	-0.802D-03	-0.636D-03	0.102D-02	0.736D-01
31.0	0.141	-152.	0.428D-04	-0.226D-04	-0.192D-03	0.285D-03	0.343D-03	0.247D-01
41.0	0.344	62.4	0.219D-04	-0.389D-04	-0.708D-04	-0.109D-03	0.130D-03	0.931D-02
51.0	0.943	-38.5	-0.543D-04	-0.759D-04	0.499D-05	-0.988D-04	0.989D-04	0.711D-02
61.0	0.209	152.	-0.639D-05	-0.791D-05	0.929D-05	0.478D-04	0.487D-04	0.350D-02
71.0	0.234	84.0	0.113D-04	-0.146D-04	-0.570D-04	-0.545D-04	0.788D-04	0.566D-02
81.0	0.239	-143.	0.131D-04	-0.273D-05	-0.368D-04	0.421D-04	0.559D-04	0.402D-02
91.0	0.321	69.7	0.638D-05	-0.610D-05	-0.109D-04	-0.252D-04	0.275D-04	0.197D-02
101.	1.02	-23.6	0.424D-06	-0.141D-04	0.591D-05	-0.125D-04	0.138D-04	0.994D-03

TABLE IV
CONTD.
RUN ID H-01

COMMENTS HE TRACER BED IN AIR RATE 6.3 CM 12/27/68

DEAD TIME= 0.650 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000 00	1.17	0.0000D 00	84.0	0.0000D 00	71.8	0.0000D 00	1.00	71.8
0.1000D-01	1.00	-0.693	0.999	-0.4550D-01	0.999	-0.3340D-01	1.00	71.8
0.2000D-01	1.00	-1.39	0.995	-0.9080D-01	0.996	-0.6670D-01	0.998	71.7
0.3000D-01	1.00	-2.08	0.988	-0.136	0.991	-0.9950D-01	0.996	71.5
0.4000D-01	1.00	-2.79	0.978	-0.180	0.984	-0.132	0.993	71.3
0.5000D-01	1.00	-3.49	0.966	-0.223	0.975	-0.163	0.989	71.0
0.6000D-01	1.00	-4.21	0.952	-0.265	0.965	-0.194	0.984	70.7
0.7000D-01	1.01	-4.93	0.935	-0.307	0.953	-0.224	0.978	70.3
0.8000D-01	1.01	-5.66	0.916	-0.346	0.939	-0.252	0.972	69.8
0.9000D-01	1.01	-6.41	0.895	-0.384	0.924	-0.280	0.965	69.3
0.100	1.01	-7.17	0.872	-0.421	0.908	-0.305	0.958	68.8
0.200	1.03	-15.5	0.574	-0.680	0.712	-0.485	0.861	61.9
0.300	1.04	-25.0	0.252	-0.759	0.527	-0.557	0.767	55.1
0.400	1.03	-34.6	-0.256D-01	-0.713	0.372	-0.583	0.691	49.6
0.500	1.02	-43.9	-0.233	-0.585	0.234	-0.573	0.619	44.5
0.600	0.992	-53.5	-0.353	-0.417	0.126	-0.536	0.551	39.6
0.700	0.956	-62.7	-0.397	-0.255	0.469D-01	-0.492	0.494	35.5
0.800	0.918	-71.7	-0.393	-0.116	-0.144D-01	-0.447	0.447	32.1
0.900	0.875	-80.6	-0.355	-0.352D-02	-0.620D-01	-0.401	0.405	29.1
1.00	0.825	-89.1	-0.294	0.763D-01	-0.983D-01	-0.355	0.369	26.5
2.00	0.388	-157.	0.401D-01	0.417D-01	-0.138	-0.576D-01	0.149	10.7
3.00	0.223	174.	0.141D-01	-0.431D-02	-0.649D-01	0.125D-01	0.661D-01	4.75
4.00	0.257	146.	0.251D-02	-0.703D-02	-0.234D-01	0.172D-01	0.290D-01	2.09
5.00	0.267	90.0	-0.278D-02	-0.282D-02	-0.106D-01	0.857D-02	0.136D-01	0.979
6.00	0.149	4.93	-0.794D-03	0.101D-02	-0.472D-02	0.716D-02	0.858D-02	0.616
7.00	0.435	-158.	0.147D-02	-0.101D-02	-0.224D-02	0.343D-02	0.409D-02	0.294
8.00	0.546	74.8	-0.147D-02	-0.469D-03	-0.154D-02	0.237D-02	0.283D-02	0.203
9.00	0.401	-29.5	-0.150D-03	0.978D-03	-0.152D-02	0.194D-02	0.246D-02	0.177
10.0	0.410	-117.	0.725D-03	-0.207D-03	-0.344D-03	0.181D-02	0.184D-02	0.132

TABLE IV

RUN ID H-01

CONTD.

DEAD TIME= 0.650 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
11.0	0.112	85.7	-0.133D-03	0.748D-04	0.578D-03	0.123D-02	0.136D-02	0.978D-01
21.0	0.262	10.2	-0.177D-03	-0.201D-03	-0.802D-03	-0.636D-03	0.102D-02	0.736D-01
31.0	0.141	134.	-0.103D-04	-0.473D-04	-0.192D-03	0.285D-03	0.343D-03	0.247D-01
41.0	0.344	-24.5	-0.377D-04	-0.239D-04	-0.708D-04	-0.109D-03	0.130D-03	0.931D-02
51.0	0.943	-138.	-0.660D-04	0.659D-04	0.499D-05	-0.988D-04	0.989D-04	0.711D-02
61.0	0.209	40.3	-0.498D-05	0.887D-05	0.929D-05	0.478D-04	0.487D-04	0.350D-02
71.0	0.234	-40.2	-0.184D-04	-0.113D-05	-0.570D-04	-0.545D-04	0.788D-04	0.566D-02
81.0	0.239	80.4	-0.114D-04	-0.701D-05	-0.368D-04	0.421D-04	0.559D-04	0.402D-02
91.0	0.321	-79.4	-0.861D-05	0.195D-05	-0.109D-04	-0.252D-04	0.275D-04	0.197D-02
101.	1.02	175.	-0.490D-05	0.133D-04	0.591D-05	-0.125D-04	0.138D-04	0.994D-03

TABLE V

RUN ID H-02

COMMENTS HE TRACER BED HT 7 3/8 IN AIR RATE 6.3 CM LINE APPROX 1/2/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.39	0.0000D 00	30.3	0.0000D 00	21.7	0.0000D 00	1.00	21.7
0.1000D-01	1.00	-0.448	0.999	-0.395D-01	0.999	-0.317D-01	1.00	21.7
0.2000D-01	1.00	-0.892	0.995	-0.787D-01	0.997	-0.632D-01	0.999	21.7
0.3000D-01	0.999	-1.33	0.989	-0.117	0.992	-0.945D-01	0.997	21.7
0.4000D-01	0.998	-1.76	0.980	-0.155	0.986	-0.125	0.994	21.6
0.5000D-01	0.997	-2.18	0.969	-0.192	0.979	-0.156	0.991	21.5
0.6000D-01	0.996	-2.59	0.956	-0.228	0.969	-0.185	0.987	21.4
0.7000D-01	0.995	-2.98	0.942	-0.262	0.959	-0.214	0.982	21.3
0.8000D-01	0.994	-3.36	0.925	-0.295	0.947	-0.242	0.977	21.2
0.9000D-01	0.993	-3.72	0.907	-0.326	0.933	-0.269	0.971	21.1
0.100	0.992	-4.07	0.888	-0.356	0.919	-0.294	0.965	21.0
0.200	0.995	-7.24	0.665	-0.570	0.735	-0.484	0.880	19.1
0.300	1.01	-11.8	0.424	-0.678	0.546	-0.568	0.788	17.1
0.400	1.00	-17.4	0.191	-0.687	0.386	-0.596	0.710	15.4
0.500	0.982	-22.0	0.778D-02	-0.628	0.247	-0.590	0.639	13.9
0.600	0.963	-26.5	-0.124	-0.537	0.133	-0.557	0.572	12.4
0.700	0.940	-31.0	-0.209	-0.436	0.487D-01	-0.512	0.515	11.2
0.800	0.913	-35.6	-0.260	-0.337	-0.170D-01	-0.466	0.467	10.1
0.900	0.883	-40.0	-0.284	-0.244	-0.686D-01	-0.418	0.424	9.21
1.00	0.852	-44.7	-0.287	-0.161	-0.107	-0.371	0.386	8.39
2.00	0.470	-73.2	-0.416D-01	0.600D-01	-0.148	-0.479D-01	0.156	3.38
3.00	0.244	-76.9	0.951D-03	0.151D-01	-0.593D-01	0.178D-01	0.620D-01	1.35
4.00	0.225	-81.6	0.328D-02	0.561D-02	-0.226D-01	0.181D-01	0.289D-01	0.628
5.00	0.149	-171.	0.138D-02	-0.161D-02	-0.737D-02	0.122D-01	0.142D-01	0.310
6.00	0.851D-01	82.3	-0.490D-03	-0.271D-03	-0.388D-02	0.532D-02	0.658D-02	0.143
7.00	0.533	109.	-0.176D-02	-0.152D-02	-0.163D-02	0.404D-02	0.436D-02	0.947D-01
8.00	0.493	46.5	-0.105D-02	0.841D-03	-0.235D-03	0.273D-02	0.274D-02	0.595D-01
9.00	0.932	29.2	-0.504D-03	0.101D-02	0.561D-04	0.121D-02	0.121D-02	0.263D-01
10.0	1.65	-55.9	0.760D-04	0.615D-03	-0.296D-03	0.232D-03	0.376D-03	0.817D-02

TABLE V

RUN ID H-02

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	1.14	-83.7	0.105D-04	0.477D-03	-0.414D-03	0.548D-04	0.417D-03	0.907D-02
21.0	0.267	82.4	0.146D-03	-0.230D-03	-0.781D-03	-0.656D-03	0.102D-02	0.222D-01
31.0	0.147	104.	-0.251D-04	-0.268D-04	-0.134D-03	0.212D-03	0.251D-03	0.545D-02
41.0	1.68	-39.3	-0.224D-04	-0.621D-04	0.131D-04	-0.370D-04	0.392D-04	0.853D-03
51.0	0.931	-32.6	-0.477D-04	-0.853D-04	0.503D-05	-0.103D-03	0.103D-03	0.224D-02
61.0	0.814	-13.4	-0.110D-04	0.311D-05	-0.140D-04	0.585D-06	0.140D-04	0.305D-03
71.0	0.312	114.	0.253D-04	-0.976D-05	-0.620D-04	-0.609D-04	0.869D-04	0.189D-02
81.0	0.149	141.	-0.943D-06	-0.599D-05	-0.203D-04	0.353D-04	0.407D-04	0.884D-03
91.0	2.48	3.59	0.136D-05	-0.117D-04	0.251D-06	-0.473D-05	0.473D-05	0.103D-03
101.	0.988	-20.6	0.126D-05	-0.140D-04	0.620D-05	-0.128D-04	0.143D-04	0.310D-03

TABLE V CONTD.

RUN ID H-02

COMMENTS HE TRACER BED HT 7 3/8 IN AIR RATE 6.3 CM LINE APPROX 1/2/69

DEAD TIME= 0.550 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.39	0.0000D 00	30.3	0.0000D 00	21.7	0.0000D 00	1.00	21.7
0.1000D-01	1.00	-0.763	0.998	-0.4500D-01	0.999	-0.3170D-01	1.00	21.7
0.2000D-01	1.00	-1.52	0.994	-0.8970D-01	0.997	-0.6320D-01	0.999	21.7
0.3000D-01	0.999	-2.28	0.987	-0.134	0.992	-0.9450D-01	0.997	21.7
0.4000D-01	0.998	-3.02	0.976	-0.177	0.986	-0.125	0.994	21.6
0.5000D-01	0.997	-3.76	0.964	-0.219	0.979	-0.156	0.991	21.5
0.6000D-01	0.996	-4.48	0.948	-0.259	0.969	-0.185	0.987	21.4
0.7000D-01	0.995	-5.19	0.931	-0.298	0.959	-0.214	0.982	21.3
0.8000D-01	0.994	-5.88	0.911	-0.335	0.947	-0.242	0.977	21.2
0.9000D-01	0.993	-6.56	0.890	-0.371	0.933	-0.269	0.971	21.1
0.100	0.992	-7.22	0.867	-0.404	0.919	-0.294	0.965	21.0
0.200	0.995	-13.5	0.598	-0.640	0.735	-0.484	0.880	19.1
0.300	1.01	-21.3	0.307	-0.738	0.546	-0.568	0.788	17.1
0.400	1.00	-30.0	0.364D-01	-0.712	0.386	-0.596	0.710	15.4
0.500	0.982	-37.7	-0.163	-0.606	0.247	-0.590	0.639	13.9
0.600	0.963	-45.4	-0.291	-0.468	0.133	-0.557	0.572	12.4
0.700	0.940	-53.1	-0.357	-0.326	0.487D-01	-0.512	0.515	11.2
0.800	0.913	-60.8	-0.379	-0.194	-0.170D-01	-0.466	0.467	10.1
0.900	0.883	-68.4	-0.366	-0.799D-01	-0.686D-01	-0.418	0.424	9.21
1.00	0.852	-76.2	-0.329	0.130D-01	-0.107	-0.371	0.386	8.39
2.00	0.470	-136.	0.346D-01	0.643D-01	-0.148	-0.479D-01	0.156	3.38
3.00	0.244	-171.	0.150D-01	-0.214D-02	-0.593D-01	0.178D-01	0.620D-01	1.35
4.00	0.225	152.	0.261D-02	-0.596D-02	-0.226D-01	0.181D-01	0.289D-01	0.628
5.00	0.149	31.8	-0.189D-02	0.965D-03	-0.737D-02	0.122D-01	0.142D-01	0.310
6.00	0.651D-01	-106.	0.526D-03	0.191D-03	-0.388D-02	0.532D-02	0.658D-02	0.143
7.00	0.533	-112.	0.233D-02	0.512D-05	-0.163D-02	0.404D-02	0.436D-02	0.947D-01
8.00	0.493	154.	-0.476D-03	-0.126D-02	-0.235D-03	0.273D-02	0.274D-02	0.595D-01
9.00	0.932	106.	-0.110D-02	-0.252D-03	0.561D-04	0.121D-02	0.121D-02	0.263D-01
10.0	1.65	-14.1	-0.380D-03	0.489D-03	-0.296D-03	0.232D-03	0.376D-03	0.817D-02

TABLE V

RUN ID H-02

CONTD.

DEAD TIME= 0.550 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	1.14	-70.3	-0.999D-04	0.466D-03	-0.414D-03	0.548D-04	0.417D-03	0.907D-02
21.0	0.267	141.	0.272D-03	0.321D-05	-0.781D-03	-0.656D-03	0.102D-02	0.222D-01
31.0	0.147	-152.	0.318D-04	-0.184D-04	-0.134D-03	0.212D-03	0.251D-03	0.545D-02
41.0	1.68	109.	0.519D-04	0.408D-04	0.131D-04	-0.370D-04	0.392D-04	0.853D-03
51.0	0.931	160.	0.279D-04	0.918D-04	0.503D-05	-0.103D-03	0.103D-03	0.224D-02
61.0	0.814	-136.	0.850D-05	0.763D-05	-0.140D-04	0.585D-06	0.140D-04	0.305D-03
71.0	0.312	37.0	-0.402D-05	-0.268D-04	-0.620D-04	-0.609D-04	0.869D-04	0.189D-02
81.0	0.149	109.	-0.402D-05	-0.454D-05	-0.203D-04	0.353D-04	0.407D-04	0.884D-03
91.0	2.46	15.9	0.382D-05	-0.111D-04	0.251D-06	-0.473D-05	0.473D-05	0.103D-03
101.	0.988	36.6	0.125D-04	-0.654D-05	0.620D-05	-0.128D-04	0.143D-04	0.310D-03

TABLE VI

RUN ID H-03

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SAMPLE LOOP 1 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.981	0.0000D 00	92.3	0.0000D 00	94.1	0.0000D 00	1.00	94.1
0.1000D-01	1.00	-0.289	0.996	-0.603D-01	0.996	-0.553D-01	0.998	93.9
0.2000D-01	0.999	-0.569	0.983	-0.119	0.985	-0.109	0.991	93.3
0.3000D-01	0.998	-0.834	0.963	-0.173	0.967	-0.159	0.980	92.3
0.4000D-01	0.996	-1.08	0.937	-0.222	0.944	-0.205	0.966	90.9
0.5000D-01	0.994	-1.29	0.906	-0.265	0.917	-0.246	0.949	89.3
0.6000D-01	0.993	-1.48	0.873	-0.301	0.887	-0.280	0.930	87.5
0.7000D-01	0.991	-1.63	0.839	-0.331	0.856	-0.310	0.910	85.6
0.8000D-01	0.989	-1.75	0.806	-0.355	0.825	-0.333	0.890	83.7
0.9000D-01	0.988	-1.86	0.774	-0.374	0.795	-0.353	0.870	81.8
0.100	0.988	-1.95	0.744	-0.390	0.767	-0.369	0.851	80.1
0.200	0.993	-3.66	0.521	-0.496	0.555	-0.465	0.724	68.2
0.300	0.997	-5.61	0.345	-0.528	0.396	-0.493	0.633	59.5
0.400	0.984	-7.70	0.193	-0.526	0.266	-0.503	0.569	53.6
0.500	0.989	-9.53	0.711D-01	-0.501	0.155	-0.487	0.511	48.1
0.600	0.975	-11.6	-0.265D-01	-0.452	0.662D-01	-0.459	0.464	43.7
0.700	0.970	-13.1	-0.101	-0.395	-0.870D-02	-0.420	0.420	39.5
0.800	0.968	-14.9	-0.155	-0.329	-0.676D-01	-0.370	0.376	35.4
0.900	0.960	-17.0	-0.187	-0.263	-0.106	-0.319	0.336	31.7
1.00	0.947	-19.0	-0.201	-0.204	-0.130	-0.273	0.303	28.5
2.00	0.852	-33.3	-0.869D-01	0.455D-01	-0.115	-0.114D-01	0.115	10.8
3.00	0.791	-48.3	-0.488D-02	0.362D-01	-0.383D-01	0.259D-01	0.462D-01	4.35
4.00	0.737	-61.3	0.926D-02	0.127D-01	-0.908D-02	0.193D-01	0.213D-01	2.01
5.00	0.661	-97.2	0.561D-02	-0.627D-05	-0.105D-02	0.842D-02	0.849D-02	0.799
6.00	0.525	-97.5	0.240D-02	-0.760D-03	0.835D-03	0.473D-02	0.480D-02	0.452
7.00	1.89	160.	-0.482D-03	-0.184D-02	-0.101D-03	0.100D-02	0.101D-02	0.947D-01
8.00	0.444	61.5	-0.673D-03	0.231D-03	-0.265D-03	0.158D-02	0.160D-02	0.151
9.00	0.664	33.9	-0.571D-03	0.561D-03	-0.243D-03	0.118D-02	0.120D-02	0.113
10.0	0.629	-29.1	0.507D-03	0.643D-03	0.207D-03	0.129D-02	0.130D-02	0.123

TABLE VI

RUN ID H-03

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.257	-2.79	0.256D-03	0.167D-03	0.963D-03	0.695D-03	0.119D-02	0.112
21.0	0.761	63.6	0.375D-03	-0.401D-03	-0.253D-03	-0.676D-03	0.722D-03	0.679D-01
31.0	0.472	-93.7	0.890D-04	-0.144D-04	0.183D-04	0.190D-03	0.191D-03	0.180D-01
41.0	0.705	-2.84	-0.120D-04	-0.431D-04	-0.140D-04	-0.619D-04	0.635D-04	0.597D-02
51.0	0.968	-13.7	-0.255D-04	-0.774D-04	-0.661D-05	-0.839D-04	0.841D-04	0.792D-02
61.0	0.242	-31.5	0.875D-05	0.334D-05	0.236D-04	0.306D-04	0.386D-04	0.363D-02
71.0	0.795	74.4	0.375D-04	-0.223D-04	-0.144D-04	-0.530D-04	0.549D-04	0.517D-02
81.0	0.402	-99.8	0.118D-04	-0.119D-05	-0.210D-05	0.295D-04	0.295D-04	0.278D-02
91.0	0.562	1.89	-0.122D-06	-0.826D-05	-0.700D-06	-0.147D-04	0.147D-04	0.138D-02
101.	0.988	-8.73	0.233D-05	-0.110D-04	0.403D-05	-0.107D-04	0.114D-04	0.107D-02

TABLE VI CONTD.

RUN ID H-03

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SAMPLE LOOP 1 LINE APP 1/6/69

DEAD TIME= 2.06 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.981	0.0000D 00	92.3	0.0000D 00	94.1	0.0000D 00	1.00	94.1
0.1000D-01	1.00	-1.47	0.994	-0.8080D-01	0.996	-0.5530D-01	0.998	93.9
0.2000D-01	0.999	-2.93	0.977	-0.159	0.985	-0.109	0.991	93.3
0.3000D-01	0.998	-4.38	0.950	-0.232	0.967	-0.159	0.980	92.3
0.4000D-01	0.996	-5.80	0.915	-0.298	0.944	-0.205	0.966	90.9
0.5000D-01	0.994	-7.19	0.874	-0.357	0.917	-0.246	0.949	89.3
0.6000D-01	0.993	-8.56	0.829	-0.406	0.887	-0.280	0.930	87.5
0.7000D-01	0.991	-9.89	0.783	-0.448	0.856	-0.310	0.910	85.6
0.8000D-01	0.989	-11.2	0.736	-0.487	0.825	-0.333	0.890	83.7
0.9000D-01	0.988	-12.5	0.692	-0.510	0.795	-0.353	0.870	81.8
0.100	0.988	-13.8	0.649	-0.534	0.767	-0.369	0.851	80.1
0.200	0.993	-27.3	0.279	-0.663	0.555	-0.465	0.724	68.2
0.300	0.997	-41.0	-0.2500D-01	-0.630	0.396	-0.493	0.633	59.5
0.400	0.984	-54.9	-0.255	-0.499	0.266	-0.503	0.569	53.6
0.500	0.989	-68.5	-0.392	-0.319	0.155	-0.487	0.511	48.1
0.600	0.975	-82.4	-0.435	-0.123	0.6620D-01	-0.459	0.464	43.7
0.700	0.970	-95.8	-0.404	0.4930D-01	-0.8700D-02	-0.420	0.420	39.5
0.800	0.968	-109.	-0.316	0.180	-0.6760D-01	-0.370	0.376	35.4
0.900	0.960	-123.	-0.200	0.253	-0.106	-0.319	0.336	31.7
1.00	0.947	-137.	-0.8600D-01	0.273	-0.130	-0.273	0.303	28.5
2.00	0.852	90.6	0.1080D-01	-0.9750D-01	-0.115	-0.1140D-01	0.115	10.8
3.00	0.791	-42.4	-0.8590D-02	0.3550D-01	-0.3830D-01	0.2590D-01	0.4620D-01	4.35
4.00	0.737	-173.	0.8270D-02	-0.1340D-01	-0.9080D-02	0.1930D-01	0.2130D-01	2.01
5.00	0.661	32.7	-0.3590D-02	0.4310D-02	-0.1050D-02	0.8420D-02	0.8490D-02	0.799
6.00	0.525	-85.7	0.2510D-02	-0.2520D-03	0.8350D-03	0.4730D-02	0.4800D-02	0.452
7.00	1.89	53.3	-0.1630D-02	0.9750D-03	-0.1010D-03	0.1000D-02	0.1010D-02	0.9470D-01
8.00	0.444	-163.	0.3210D-03	-0.6350D-03	-0.2650D-03	0.1580D-02	0.1600D-02	0.151
9.00	0.664	51.6	-0.7150D-03	0.3600D-03	-0.2430D-03	0.1180D-02	0.1200D-02	0.113
10.0	0.629	-129.	0.5420D-03	-0.6140D-03	0.2070D-03	0.1290D-02	0.1300D-02	0.123

TABLE VI

RUN ID H-03

CONTD.

DEAD TIME= 2.06 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.257	139.	-0.304D-03	0.283D-04	0.963D-03	0.695D-03	0.119D-02	0.112
21.0	0.761	105.	0.546D-03	-0.534D-04	-0.253D-03	-0.676D-03	0.722D-03	0.679D-01
31.0	0.472	-153.	0.337D-04	-0.837D-04	0.183D-04	0.190D-03	0.191D-03	0.180D-01
41.0	0.705	-162.	-0.402D-05	0.445D-04	-0.140D-04	-0.619D-04	0.635D-04	0.597D-02
51.0	0.968	86.8	0.807D-04	-0.109D-04	-0.661D-05	-0.839D-04	0.841D-04	0.792D-02
61.0	0.242	-31.2	0.873D-05	0.337D-05	0.236D-04	0.306D-04	0.386D-04	0.363D-02
71.0	0.795	-25.7	-0.286D-04	-0.330D-04	-0.144D-04	-0.530D-04	0.549D-04	0.517D-02
81.0	0.402	59.8	-0.107D-04	0.523D-05	-0.210D-05	0.295D-04	0.295D-04	0.278D-02
91.0	0.562	61.2	0.704D-05	-0.432D-05	-0.700D-06	-0.147D-04	0.147D-04	0.138D-02
101.	0.988	-49.7	-0.547D-05	-0.986D-05	0.403D-05	-0.107D-04	0.114D-04	0.107D-02

TABLE VII

RUN ID H-04

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 1 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000 00	0.974	0.0000 00	92.4	0.0000 00	94.9	0.0000 00	1.00	94.9
0.1000-01	1.00	-0.166	0.997	-0.5500-01	0.997	-0.5210-01	0.998	94.7
0.2000-01	1.00	-0.334	0.986	-0.109	0.987	-0.103	0.992	94.1
0.3000-01	1.00	-0.508	0.970	-0.159	0.971	-0.151	0.983	93.2
0.4000-01	1.00	-0.688	0.949	-0.206	0.950	-0.195	0.970	92.0
0.5000-01	1.00	-0.875	0.923	-0.249	0.926	-0.234	0.955	90.6
0.6000-01	1.00	-1.07	0.894	-0.286	0.896	-0.269	0.938	89.0
0.7000-01	1.00	-1.27	0.864	-0.318	0.870	-0.298	0.919	87.2
0.8000-01	1.00	-1.48	0.834	-0.345	0.841	-0.323	0.901	85.4
0.9000-01	1.00	-1.69	0.803	-0.368	0.813	-0.343	0.882	83.7
0.100	1.00	-1.90	0.774	-0.387	0.786	-0.360	0.864	82.0
0.200	0.999	-3.45	0.551	-0.503	0.581	-0.469	0.746	70.8
0.300	1.01	-5.51	0.364	-0.546	0.410	-0.503	0.649	61.5
0.400	1.00	-8.27	0.206	-0.550	0.282	-0.513	0.586	55.6
0.500	1.00	-9.59	0.7940-01	-0.523	0.165	-0.502	0.528	50.1
0.600	0.995	-12.3	-0.2600-01	-0.471	0.7530-01	-0.469	0.475	45.0
0.700	0.991	-14.3	-0.106	-0.411	-0.5790-03	-0.429	0.429	40.7
0.800	0.973	-16.2	-0.158	-0.343	-0.5720-01	-0.384	0.389	36.9
0.900	0.967	-18.1	-0.193	-0.277	-0.101	-0.334	0.349	33.1
1.00	0.958	-19.8	-0.208	-0.216	-0.128	-0.286	0.313	29.7
2.00	0.856	-35.4	-0.9190-01	0.4750-01	-0.120	-0.1680-01	0.121	11.5
3.00	0.756	-51.1	-0.6040-02	0.3740-01	-0.4360-01	0.2490-01	0.5020-01	4.76
4.00	0.677	-65.5	0.9540-02	0.1300-01	-0.1170-01	0.2080-01	0.2380-01	2.26
5.00	0.577	-94.2	0.5920-02	0.8840-03	-0.2270-02	0.9950-02	0.1020-01	0.968
6.00	0.449	-96.4	0.2470-02	-0.4200-03	0.3150-03	0.5570-02	0.5580-02	0.530
7.00	0.661	170.	-0.4730-03	-0.1880-02	0.1500-03	0.2250-02	0.2250-02	0.214
8.00	0.380	52.3	-0.6770-03	0.7170-03	0.4060-03	0.2560-02	0.2590-02	0.246
9.00	1.14	43.0	-0.4360-03	0.8250-03	0.2140-03	0.7900-03	0.8180-03	0.7760-01
10.0	0.756	-0.4750-01	0.1650-04	0.9290-03	0.2340-04	0.1230-02	0.1230-02	0.117

TABLE VII

RUN ID U-04

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.620	36.5	0.290D-03	0.619D-03	0.970D-03	0.524D-03	0.110D-02	0.105
21.0	0.678	67.4	0.379D-03	-0.410D-03	-0.343D-03	-0.747D-03	0.822D-03	0.780D-01
31.0	0.407	-94.1	0.871D-04	-0.866D-05	0.573D-05	0.215D-03	0.215D-03	0.204D-01
41.0	0.671	-15.4	-0.393D-05	-0.302D-04	0.634D-05	-0.450D-04	0.454D-04	0.431D-02
51.0	0.985	-15.2	-0.263D-04	-0.803D-04	-0.438D-05	-0.857D-04	0.858D-04	0.814D-02
61.0	0.405	27.3	0.619D-05	0.158D-04	0.315D-04	0.276D-04	0.418D-04	0.397D-02
71.0	0.666	75.9	0.354D-04	-0.232D-04	-0.208D-04	-0.599D-04	0.634D-04	0.602D-02
81.0	0.377	-100.	0.131D-04	-0.194D-05	-0.127D-05	0.351D-04	0.351D-04	0.333D-02
91.0	0.649	-27.0	-0.297D-05	-0.527D-05	-0.394D-06	-0.931D-05	0.932D-05	0.884D-03
101.	0.996	-9.07	0.252D-05	-0.115D-04	0.432D-05	-0.110D-04	0.118D-04	0.112D-02

TABLE VII CONTD.

RUN ID H-04

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 1 LINE APP 1/6/69

DEAD TIME= 2.06 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.974	0.0000D 00	92.4	0.0000D 00	94.9	0.0000D 00	1.00	94.9
0.1000D-01	1.00	-1.35	0.995	-0.755D-01	0.997	-0.521D-01	0.998	94.7
0.2000D-01	1.00	-2.69	0.981	-0.149	0.987	-0.103	0.992	94.1
0.3000D-01	1.00	-4.05	0.958	-0.219	0.971	-0.151	0.983	93.2
0.4000D-01	1.00	-5.41	0.928	-0.284	0.950	-0.195	0.970	92.0
0.5000D-01	1.00	-6.78	0.892	-0.342	0.926	-0.234	0.955	90.6
0.6000D-01	1.00	-8.15	0.852	-0.394	0.898	-0.269	0.938	89.0
0.7000D-01	1.00	-9.54	0.810	-0.439	0.870	-0.298	0.919	87.2
0.8000D-01	1.00	-10.9	0.766	-0.477	0.841	-0.323	0.901	85.4
0.9000D-01	1.00	-12.3	0.722	-0.509	0.813	-0.343	0.882	83.7
0.100	1.00	-13.7	0.679	-0.537	0.786	-0.360	0.864	82.0
0.200	0.999	-27.1	0.393	-0.681	0.581	-0.469	0.746	70.8
0.300	1.01	-40.9	-0.196D-01	-0.656	0.410	-0.503	0.649	61.5
0.400	1.00	-55.5	-0.264	-0.525	0.282	-0.513	0.586	55.6
0.500	1.00	-68.6	-0.407	-0.337	0.165	-0.502	0.528	50.1
0.600	0.995	-83.1	-0.454	-0.130	0.753D-01	-0.469	0.475	45.0
0.700	0.991	-96.9	-0.421	0.518D-01	-0.579D-03	-0.429	0.429	40.7
0.800	0.973	-111.	-0.330	0.184	-0.572D-01	-0.384	0.389	36.9
0.900	0.967	-124.	-0.212	0.263	-0.101	-0.334	0.349	33.1
1.00	0.958	-138.	-0.927D-01	0.286	-0.128	-0.286	0.313	29.7
2.00	0.856	88.6	0.119D-01	-0.103	-0.120	-0.168D-01	0.121	11.5
3.00	0.756	-45.2	-0.987D-02	0.366D-01	-0.436D-01	0.249D-01	0.502D-01	4.76
4.00	0.677	-178.	0.848D-02	-0.137D-01	-0.117D-01	0.208D-01	0.238D-01	2.26
5.00	0.577	35.7	-0.441D-02	0.390D-02	-0.227D-02	0.995D-02	0.102D-01	0.968
6.00	0.449	-84.6	0.251D-02	0.958D-04	0.315D-03	0.557D-02	0.558D-02	0.530
7.00	0.861	63.5	-0.167D-02	0.979D-03	0.150D-03	0.225D-02	0.225D-02	0.214
8.00	0.380	-172.	-0.153D-04	-0.986D-03	0.406D-03	0.256D-02	0.259D-02	0.246
9.00	1.14	60.8	-0.667D-03	0.653D-03	0.214D-03	0.790D-03	0.818D-03	0.776D-01
10.0	0.756	-100.	0.911D-03	-0.184D-03	0.234D-04	0.123D-02	0.123D-02	0.117

TABLE VII

RUN ID H-04

CONTD.

DEAD TIME= 2.06 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
11.0	0.620	178.	-0.612D-03	-0.306D-03	0.970D-03	0.524D-03	0.110D-02	0.105
21.0	0.678	109.	0.555D-03	-0.572D-04	-0.343D-03	-0.747D-03	0.822D-03	0.780D-01
31.0	0.407	-153.	0.376D-04	-0.791D-04	0.573D-05	0.215D-03	0.215D-03	0.204D-01
41.0	0.671	-175.	-0.706D-05	0.297D-04	0.634D-05	-0.450D-04	0.454D-04	0.431D-02
51.0	0.985	85.3	0.837D-04	-0.112D-04	-0.438D-05	-0.857D-04	0.858D-04	0.814D-02
61.0	0.405	27.5	0.614D-05	0.158D-04	0.315D-04	0.276D-04	0.418D-04	0.397D-02
71.0	0.666	-24.2	-0.290D-04	-0.308D-04	-0.208D-04	-0.599D-04	0.634D-04	0.602D-02
81.0	0.377	59.1	-0.116D-04	0.639D-05	-0.127D-05	0.351D-04	0.351D-04	0.333D-02
91.0	0.649	37.3	0.302D-05	-0.525D-05	-0.394D-06	-0.931D-05	0.932D-05	0.884D-03
101.	0.996	-50.0	-0.562D-05	-0.103D-04	0.432D-05	-0.110D-04	0.118D-04	0.112D-02

TABLE VIII

RUN ID H-05

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.02	0.0000D 00	23.5	0.0000D 00	23.1	0.0000D 00	1.00	23.1
0.1000D-01	1.00	-0.256	0.997	-0.538D-01	0.997	-0.493D-01	0.998	23.0
0.2000D-01	0.999	-0.504	0.987	-0.106	0.989	-0.977D-01	0.994	22.9
0.3000D-01	0.998	-0.736	0.971	-0.156	0.975	-0.144	0.986	22.8
0.4000D-01	0.996	-0.945	0.950	-0.203	0.957	-0.188	0.976	22.5
0.5000D-01	0.994	-1.13	0.925	-0.245	0.935	-0.228	0.963	22.2
0.6000D-01	0.992	-1.27	0.897	-0.282	0.910	-0.264	0.948	21.9
0.7000D-01	0.990	-1.39	0.867	-0.314	0.883	-0.296	0.931	21.5
0.8000D-01	0.989	-1.46	0.836	-0.341	0.854	-0.323	0.913	21.1
0.9000D-01	0.988	-1.51	0.805	-0.364	0.824	-0.347	0.894	20.6
0.100	0.987	-1.54	0.775	-0.382	0.795	-0.366	0.875	20.2
0.200	1.00	-2.98	0.543	-0.481	0.584	-0.449	0.737	17.0
0.300	0.994	-4.81	0.381	-0.531	0.427	-0.501	0.658	15.2
0.400	1.01	-6.85	0.239	-0.541	0.300	-0.506	0.588	13.6
0.500	0.992	-8.64	0.108	-0.517	0.186	-0.499	0.532	12.3
0.600	0.990	-10.7	0.927D-02	-0.476	0.982D-01	-0.471	0.481	11.1
0.700	0.983	-12.0	-0.714D-01	-0.422	0.176D-01	-0.435	0.435	10.0
0.800	0.975	-14.2	-0.128	-0.358	-0.369D-01	-0.388	0.390	9.00
0.900	0.969	-15.4	-0.164	-0.298	-0.816D-01	-0.342	0.351	8.10
1.00	0.959	-17.4	-0.184	-0.241	-0.108	-0.297	0.316	7.29
2.00	0.862	-31.1	-0.102	0.278D-01	-0.118	-0.333D-01	0.122	2.82
3.00	0.753	-42.9	-0.179D-01	0.334D-01	-0.477D-01	0.164D-01	0.504D-01	1.16
4.00	0.715	-53.3	0.316D-02	0.153D-01	-0.145D-01	0.163D-01	0.219D-01	0.505
5.00	0.530	-83.3	0.348D-02	0.300D-02	-0.485D-02	0.717D-02	0.865D-02	0.200
6.00	0.373	-96.0	0.183D-02	0.104D-02	-0.329D-02	0.460D-02	0.565D-02	0.130
7.00	0.583	119.	-0.662D-03	-0.941D-03	-0.846D-03	0.178D-02	0.197D-02	0.455D-01
8.00	0.613	13.2	-0.653D-03	0.593D-03	-0.818D-03	0.119D-02	0.144D-02	0.332D-01
9.00	0.444	10.7	-0.716D-03	0.179D-03	-0.151D-02	0.696D-03	0.166D-02	0.384D-01
10.0	0.671	-27.8	-0.112D-03	0.111D-02	-0.919D-03	0.139D-02	0.166D-02	0.384D-01

TABLE VIII

RUN ID H-05

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	1.23	-48.4	0.750D-03	0.607D-03	0.357D-04	0.782D-03	0.783D-03	0.181D-01
21.0	0.716	57.8	0.167D-03	-0.504D-03	-0.472D-03	-0.572D-03	0.742D-03	0.171D-01
31.0	0.372	-89.2	0.598D-04	0.502D-04	-0.133D-03	0.160D-03	0.208D-03	0.480D-02
41.0	0.634	-0.448	-0.525D-04	-0.255D-04	-0.824D-04	-0.409D-04	0.920D-04	0.212D-02
51.0	0.985	-12.7	-0.195D-04	-0.830D-04	-0.772D-06	-0.866D-04	0.866D-04	0.200D-02
61.0	1.22	-33.1	0.190D-04	0.303D-04	-0.122D-05	0.288D-04	0.288D-04	0.665D-03
71.0	0.716	66.7	0.209D-04	-0.345D-04	-0.327D-04	-0.459D-04	0.564D-04	0.130D-02
81.0	0.342	-87.3	0.705D-05	0.657D-05	-0.182D-04	0.215D-04	0.282D-04	0.651D-03
91.0	0.840	17.2	-0.992D-05	-0.124D-04	-0.147D-04	-0.120D-04	0.190D-04	0.437D-03
101.	0.994	-8.33	0.311D-05	-0.114D-04	0.476D-05	-0.109D-04	0.119D-04	0.274D-03

TABLE VIII CONTD.

RUN ID H-05

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 2.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.02	0.0000D 00	23.5	0.0000D 00	23.1	0.0000D 00	1.00	23.1
0.1000D-01	1.00	-1.46	0.995	-0.747D-01	0.997	-0.493D-01	0.998	23.0
0.2000D-01	0.999	-2.91	0.982	-0.148	0.989	-0.977D-01	0.994	22.9
0.3000D-01	0.998	-4.35	0.960	-0.217	0.975	-0.144	0.986	22.8
0.4000D-01	0.996	-5.76	0.930	-0.282	0.957	-0.188	0.976	22.5
0.5000D-01	0.994	-7.14	0.895	-0.340	0.935	-0.228	0.963	22.2
0.6000D-01	0.992	-8.49	0.855	-0.393	0.910	-0.264	0.948	21.9
0.7000D-01	0.990	-9.81	0.812	-0.438	0.883	-0.296	0.931	21.5
0.8000D-01	0.989	-11.1	0.767	-0.476	0.854	-0.323	0.913	21.1
0.9000D-01	0.988	-12.3	0.722	-0.508	0.824	-0.347	0.894	20.6
0.100	0.987	-13.6	0.678	-0.535	0.795	-0.366	0.875	20.2
0.200	1.00	-27.0	0.318	-0.669	0.584	-0.449	0.737	17.0
0.300	0.994	-40.9	-0.482D-02	-0.654	0.427	-0.501	0.658	15.2
0.400	1.01	-55.0	-0.243	-0.540	0.300	-0.506	0.588	13.6
0.500	0.992	-68.8	-0.394	-0.351	0.186	-0.499	0.532	12.3
0.600	0.990	-82.9	-0.450	-0.154	0.982D-01	-0.471	0.481	11.1
0.700	0.983	-96.2	-0.427	0.286D-01	0.176D-01	-0.435	0.435	10.0
0.800	0.975	-110.	-0.342	0.166	-0.369D-01	-0.388	0.390	9.00
0.900	0.969	-124.	-0.232	0.249	-0.816D-01	-0.342	0.351	8.10
1.00	0.959	-138.	-0.115	0.280	-0.108	-0.297	0.316	7.29
2.00	0.862	88.3	0.256D-01	-0.102	-0.118	-0.333D-01	0.122	2.82
3.00	0.753	-43.9	-0.173D-01	0.337D-01	-0.477D-01	0.164D-01	0.504D-01	1.16
4.00	0.715	-175.	0.114D-01	-0.107D-01	-0.145D-01	0.163D-01	0.219D-01	0.505
5.00	0.530	35.1	-0.429D-02	0.163D-02	-0.485D-02	0.717D-02	0.865D-02	0.200
6.00	0.373	-98.0	0.187D-02	0.979D-03	-0.329D-02	0.460D-02	0.565D-02	0.130
7.00	0.583	-2.78	-0.443D-03	0.106D-02	-0.846D-03	0.178D-02	0.197D-02	0.455D-01
8.00	0.613	131.	-0.275D-03	-0.853D-03	-0.618D-03	0.119D-02	0.144D-02	0.332D-01
9.00	0.444	7.79	-0.706D-03	0.215D-03	-0.151D-02	0.696D-03	0.166D-02	0.384D-01
10.0	0.671	-151.	0.900D-03	-0.515D-03	-0.919D-03	0.139D-02	0.166D-02	0.384D-01

TABLE VIII

RUN ID 4-05

CONTD.

DEAD TIME= 2.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	1.23	68.1	-0.878D-03	0.400D-03	0.357D-04	0.782D-03	0.783D-03	0.181D-01
21.0	0.716	51.0	0.106D-03	-0.520D-03	-0.472D-03	-0.572D-03	0.742D-03	0.171D-01
31.0	0.372	141.	0.682D-06	-0.773D-04	-0.133D-03	0.160D-03	0.208D-03	0.480D-02
41.0	0.634	106.	0.396D-04	-0.428D-04	-0.824D-04	-0.409D-04	0.920D-04	0.212D-02
51.0	0.985	-29.1	-0.421D-04	-0.742D-04	-0.772D-06	-0.866D-04	0.866D-04	0.200D-02
61.0	1.22	-173.	0.593D-05	-0.347D-04	-0.122D-05	0.288D-04	0.288D-04	0.665D-03
71.0	0.716	164.	0.316D-04	0.251D-04	-0.327D-04	-0.459D-04	0.564D-04	0.130D-02
81.0	0.342	-113.	0.922D-05	0.281D-05	-0.182D-04	0.215D-04	0.282D-04	0.651D-03
91.0	0.840	-137.	0.216D-05	0.158D-04	-0.147D-04	-0.120D-04	0.190D-04	0.437D-03
101.	0.994	79.2	0.115D-04	0.262D-05	0.476D-05	-0.109D-04	0.119D-04	0.274D-03

TABLE IX
RUN ID H-06

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.987	0.0000D 00	23.3	0.0000D 00	23.6	0.0000D 00	1.00	23.6
0.1000D-01	1.00	0.331	0.997	-0.530D-01	0.996	-0.587D-01	0.997	23.5
0.2000D-01	1.00	0.638	0.988	-0.105	0.983	-0.115	0.989	23.3
0.3000D-01	1.01	0.899	0.973	-0.154	0.962	-0.168	0.977	23.0
0.4000D-01	1.01	1.09	0.953	-0.200	0.935	-0.215	0.959	22.6
0.5000D-01	1.02	1.20	0.929	-0.242	0.903	-0.256	0.939	22.2
0.6000D-01	1.03	1.19	0.902	-0.280	0.869	-0.289	0.916	21.6
0.7000D-01	1.04	1.07	0.873	-0.312	0.833	-0.316	0.891	21.0
0.8000D-01	1.05	0.822	0.843	-0.340	0.799	-0.336	0.866	20.4
0.9000D-01	1.06	0.457	0.813	-0.364	0.766	-0.350	0.842	19.9
0.100	1.06	-0.111D-01	0.783	-0.384	0.736	-0.360	0.820	19.3
0.200	1.05	-3.51	0.564	-0.492	0.565	-0.434	0.712	16.8
0.300	1.07	-5.77	0.391	-0.546	0.406	-0.472	0.622	14.7
0.400	1.06	-7.71	0.226	-0.553	0.281	-0.489	0.564	13.3
0.500	1.06	-10.5	0.943D-01	-0.526	0.178	-0.473	0.506	11.9
0.600	1.05	-12.4	-0.811D-02	-0.479	0.902D-01	-0.445	0.454	10.7
0.700	1.05	-14.4	-0.891D-01	-0.427	0.181D-01	-0.412	0.413	9.74
0.800	1.04	-17.2	-0.144	-0.356	-0.307D-01	-0.368	0.370	8.72
0.900	1.03	-19.1	-0.182	-0.292	-0.743D-01	-0.326	0.334	7.89
1.00	1.01	-20.9	-0.199	-0.232	-0.103	-0.285	0.303	7.16
2.00	0.892	-38.5	-0.976D-01	0.402D-01	-0.114	-0.329D-01	0.118	2.79
3.00	0.815	-53.6	-0.119D-01	0.364D-01	-0.446D-01	0.148D-01	0.470D-01	1.11
4.00	0.744	-72.7	0.709D-02	0.136D-01	-0.147D-01	0.145D-01	0.206D-01	0.487
5.00	0.499	-96.4	0.401D-02	0.219D-02	-0.525D-02	0.750D-02	0.915D-02	0.216
6.00	0.424	-115.	0.201D-02	0.448D-03	-0.294D-02	0.387D-02	0.486D-02	0.115
7.00	0.509	175.	-0.259D-03	-0.141D-02	-0.200D-02	0.200D-02	0.283D-02	0.667D-01
8.00	0.981D-01	4.39	-0.133D-03	0.180D-03	-0.121D-02	0.193D-02	0.228D-02	0.538D-01
9.00	0.434	9.00	-0.347D-03	0.701D-03	-0.537D-03	0.172D-02	0.180D-02	0.425D-01
10.0	0.302	-13.4	-0.887D-04	0.626D-03	-0.765D-03	0.195D-02	0.209D-02	0.494D-01

TABLE IX

RUN ID H-06

CONTD.

DEAD TIME= 0.000D 00. PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.625	-30.7	0.616D-03	0.315D-03	0.590D-03	0.937D-03	0.111D-02	0.261D-01
21.0	0.732	77.2	0.279D-03	-0.431D-03	-0.490D-03	-0.502D-03	0.701D-03	0.165D-01
31.0	0.390	-116.	0.736D-04	0.127D-04	-0.111D-03	0.156D-03	0.192D-03	0.452D-02
41.0	0.579	25.2	0.354D-05	-0.349D-04	-0.201D-04	-0.571D-04	0.605D-04	0.143D-02
51.0	1.05	-15.2	-0.231D-04	-0.827D-04	-0.518D-06	-0.819D-04	0.819D-04	0.193D-02
61.0	0.489	-26.3	0.134D-04	0.122D-04	0.136D-04	0.346D-04	0.372D-04	0.878D-03
71.0	0.693	86.5	0.285D-04	-0.277D-04	-0.374D-04	-0.434D-04	0.573D-04	0.135D-02
81.0	0.445	-116.	0.136D-04	0.264D-05	-0.186D-04	0.249D-04	0.311D-04	0.733D-03
91.0	0.284	36.2	-0.502D-06	-0.423D-05	-0.102D-04	-0.110D-04	0.150D-04	0.354D-03
101.	1.06	-9.70	0.294D-05	-0.116D-04	0.447D-05	-0.103D-04	0.112D-04	0.265D-03

TABLE IX

RUN ID H-06

COMMENTS HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 2.05 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.987	0.0000D 00	23.3	0.0000D 00	23.6	0.0000D 00	1.00	23.6
0.1000D-01	1.00	-0.844	0.996	-0.734D-01	0.996	-0.587D-01	0.997	23.5
0.2000D-01	1.00	-1.71	0.992	-0.145	0.983	-0.115	0.989	23.3
0.3000D-01	1.01	-2.62	0.961	-0.214	0.962	-0.168	0.977	23.0
0.4000D-01	1.01	-3.61	0.933	-0.278	0.935	-0.215	0.959	22.6
0.5000D-01	1.02	-4.68	0.899	-0.336	0.903	-0.256	0.939	22.2
0.6000D-01	1.03	-5.86	0.861	-0.368	0.869	-0.289	0.916	21.6
0.7000D-01	1.04	-7.15	0.819	-0.434	0.833	-0.316	0.891	21.0
0.8000D-01	1.05	-8.57	0.776	-0.473	0.799	-0.336	0.866	20.4
0.9000D-01	1.06	-10.1	0.732	-0.507	0.766	-0.350	0.842	19.9
0.100	1.06	-11.8	0.689	-0.535	0.736	-0.360	0.820	19.3
0.200	1.05	-27.0	0.322	-0.676	0.565	-0.434	0.712	16.8
0.300	1.07	-41.0	-0.386D-02	-0.666	0.406	-0.472	0.622	14.7
0.400	1.06	-54.7	-0.250	-0.543	0.281	-0.489	0.564	13.3
0.500	1.06	-69.2	-0.401	-0.354	0.178	-0.473	0.506	11.9
0.600	1.05	-82.9	-0.454	-0.152	0.902D-01	-0.445	0.454	10.7
0.700	1.05	-96.7	-0.430	0.317D-01	0.181D-01	-0.412	0.413	9.74
0.800	1.04	-111.	-0.346	0.168	-0.307D-01	-0.368	0.370	8.72
0.900	1.03	-125.	-0.232	0.254	-0.743D-01	-0.326	0.334	7.89
1.00	1.01	-138.	-0.114	0.264	-0.103	-0.285	0.303	7.16
2.00	0.892	86.6	0.232D-01	-0.103	-0.114	-0.329D-01	0.118	2.79
3.00	0.815	-46.0	-0.166D-01	0.345D-01	-0.446D-01	0.148D-01	0.470D-01	1.11
4.00	0.744	177.	0.104D-01	-0.113D-01	-0.147D-01	0.145D-01	0.206D-01	0.487
5.00	0.499	36.3	-0.433D-02	0.146D-02	-0.525D-02	0.750D-02	0.915D-02	0.216
6.00	0.424	-99.4	0.183D-02	0.962D-03	-0.294D-02	0.387D-02	0.486D-02	0.115
7.00	0.509	22.4	-0.133D-02	0.551D-03	-0.200D-02	0.200D-02	0.283D-02	0.667D-01
8.00	0.981D-01	145.	-0.130D-04	-0.223D-03	-0.121D-02	0.193D-02	0.228D-02	0.538D-01
9.00	0.434	31.9	-0.592D-03	0.511D-03	-0.537D-03	0.172D-02	0.180D-02	0.425D-01
10.0	0.302	-108.	0.631D-03	0.386D-04	-0.765D-03	0.195D-02	0.209D-02	0.494D-01

TABLE IX

RUN ID H-06

CONTD.

DEAD TIME= 2.05 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.625	117.	-0.689D-03	0.597D-04	0.590D-03	0.937D-03	0.111D-02	0.261D-01
21.0	0.732	131.	0.512D-03	-0.329D-04	-0.490D-03	-0.502D-03	0.701D-03	0.165D-01
31.0	0.390	-157.	0.638D-04	-0.399D-04	-0.111D-03	0.156D-03	0.192D-03	0.452D-02
41.0	0.579	-111.	-0.269D-04	0.225D-04	-0.201D-04	-0.571D-04	0.605D-04	0.143D-02
51.0	1.05	114.	0.784D-04	0.351D-04	-0.518D-06	-0.819D-04	0.819D-04	0.193D-02
61.0	0.489	8.87	0.394D-05	0.177D-04	0.136D-04	0.346D-04	0.372D-04	0.878D-03
71.0	0.693	27.1	-0.939D-05	-0.386D-04	-0.374D-04	-0.434D-04	0.573D-04	0.135D-02
81.0	0.445	90.3	-0.110D-04	-0.832D-05	-0.186D-04	0.249D-04	0.311D-04	0.733D-03
91.0	0.284	148.	0.412D-05	0.108D-05	-0.102D-04	-0.110D-04	0.150D-04	0.354D-03
101.	1.06	7.20	0.608D-05	-0.103D-04	0.447D-05	-0.103D-04	0.112D-04	0.265D-03

JRTRAN ** STOP

TABLE X

RUN ID H-07

COMMENTS HE BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 2 LINE APP 1/9/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.13	0.0000D 00	86.7	0.0000D 00	76.7	0.0000D 00	1.00	76.7
0.1000D-02	1.00	-0.2500D-01	1.00	-0.435D-02	1.00	-0.391D-02	1.00	76.7
0.2000D-02	1.00	-0.5000D-01	1.00	-0.870D-02	1.00	-0.783D-02	1.00	76.7
0.3000D-02	1.00	-0.751D-01	1.00	-0.130D-01	1.00	-0.117D-01	1.00	76.7
0.4000D-02	1.00	-0.100	1.00	-0.174D-01	1.00	-0.156D-01	1.00	76.7
0.5000D-02	1.00	-0.125	1.00	-0.217D-01	1.00	-0.196D-01	1.00	76.7
0.6000D-02	1.00	-0.150	0.999	-0.261D-01	0.999	-0.235D-01	1.00	76.7
0.7000D-02	1.00	-0.175	0.999	-0.304D-01	0.999	-0.274D-01	1.00	76.7
0.8000D-02	1.00	-0.201	0.999	-0.348D-01	0.999	-0.313D-01	0.999	76.6
0.9000D-02	1.00	-0.226	0.999	-0.391D-01	0.999	-0.352D-01	0.999	76.6
0.1000D-01	1.00	-0.251	0.998	-0.434D-01	0.998	-0.390D-01	0.999	76.6
0.2000D-01	1.00	-0.509	0.994	-0.865D-01	0.993	-0.776D-01	0.996	76.4
0.3000D-01	1.00	-0.781	0.986	-0.129	0.985	-0.115	0.992	76.1
0.4000D-01	1.00	-1.07	0.975	-0.170	0.974	-0.151	0.985	75.6
0.5000D-01	1.01	-1.39	0.962	-0.210	0.960	-0.185	0.978	75.0
0.6000D-01	1.01	-1.73	0.946	-0.248	0.944	-0.217	0.968	74.3
0.7000D-01	1.01	-2.12	0.928	-0.285	0.926	-0.247	0.958	73.5
0.8000D-01	1.02	-2.53	0.909	-0.319	0.906	-0.274	0.947	72.6
0.9000D-01	1.02	-2.99	0.887	-0.352	0.886	-0.299	0.935	71.7
0.100	1.02	-3.48	0.864	-0.382	0.865	-0.321	0.923	70.8
0.200	1.03	-9.44	0.615	-0.581	0.681	-0.458	0.820	62.9
0.300	1.02	-14.4	0.373	-0.671	0.516	-0.546	0.753	57.7
0.400	1.01	-20.2	0.138	-0.670	0.357	-0.574	0.676	51.8
0.500	0.980	-25.8	-0.453D-01	-0.596	0.223	-0.568	0.610	46.8
0.600	0.950	-31.4	-0.173	-0.489	0.113	-0.534	0.546	41.9
0.700	0.903	-37.0	-0.245	-0.369	0.294D-01	-0.490	0.491	37.7
0.800	0.856	-42.3	-0.276	-0.260	-0.337D-01	-0.441	0.443	33.9
0.900	0.793	-47.6	-0.275	-0.163	-0.818D-01	-0.394	0.403	30.9
1.00	0.733	-51.7	-0.253	-0.889D-01	-0.119	-0.346	0.366	28.1

TABLE X

RUN ID H-07

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.202	-70.2	-0.173D-01	0.241D-01	-0.141	-0.398D-01	0.146	11.2
3.00	0.186	4.70	-0.113D-01	0.352D-02	-0.591D-01	0.238D-01	0.637D-01	4.89
4.00	0.216	-13.2	-0.269D-02	0.610D-02	-0.186D-01	0.246D-01	0.308D-01	2.36
5.00	0.134	54.5	-0.155D-02	0.755D-03	-0.214D-02	0.127D-01	0.129D-01	0.988
6.00	0.254	37.4	-0.115D-02	0.143D-02	-0.190D-03	0.722D-02	0.722D-02	0.554
7.00	0.409	158.	-0.123D-02	-0.662D-03	0.216D-02	0.264D-02	0.341D-02	0.262
8.00	1.76	57.5	-0.111D-02	0.123D-02	0.250D-03	0.910D-03	0.943D-03	0.724D-01
9.00	6.49	74.6	-0.850D-03	0.157D-02	0.198D-03	0.191D-03	0.275D-03	0.211D-01
10.0	0.621	-143.	0.221D-03	0.224D-03	-0.502D-03	-0.706D-04	0.507D-03	0.389D-01

TABLE X CONTD.

RUN ID H-07

COMMENTS HE BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 2 LINE APP 1/9/69

DEAD TIME= 0.480 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.13	0.0000D 00	86.7	0.0000D 00	76.7	0.0000D 00	1.00	76.7
0.1000D-02	1.00	-0.5250D-01	1.00	-0.4830D-02	1.00	-0.3910D-02	1.00	76.7
0.2000D-02	1.00	-0.105	1.00	-0.9660D-02	1.00	-0.7830D-02	1.00	76.7
0.3000D-02	1.00	-0.158	1.00	-0.1450D-01	1.00	-0.1170D-01	1.00	76.7
0.4000D-02	1.00	-0.210	1.00	-0.1930D-01	1.00	-0.1560D-01	1.00	76.7
0.5000D-02	1.00	-0.263	1.00	-0.2410D-01	1.00	-0.1960D-01	1.00	76.7
0.6000D-02	1.00	-0.315	0.999	-0.2900D-01	0.999	-0.2350D-01	1.00	76.7
0.7000D-02	1.00	-0.368	0.999	-0.3380D-01	0.999	-0.2740D-01	1.00	76.7
0.8000D-02	1.00	-0.421	0.999	-0.3860D-01	0.999	-0.3130D-01	0.999	76.6
0.9000D-02	1.00	-0.473	0.999	-0.4340D-01	0.999	-0.3520D-01	0.999	76.6
0.1000D-01	1.00	-0.526	0.998	-0.4820D-01	0.998	-0.3900D-01	0.999	76.6
0.2000D-01	1.00	-1.06	0.993	-0.9600D-01	0.993	-0.7760D-01	0.996	76.4
0.3000D-01	1.00	-1.61	0.984	-0.143	0.985	-0.115	0.992	76.1
0.4000D-01	1.00	-2.17	0.972	-0.189	0.974	-0.151	0.985	75.6
0.5000D-01	1.01	-2.76	0.957	-0.233	0.960	-0.185	0.978	75.0
0.6000D-01	1.01	-3.38	0.939	-0.276	0.944	-0.217	0.968	74.3
0.7000D-01	1.01	-4.04	0.918	-0.316	0.926	-0.247	0.958	73.5
0.8000D-01	1.02	-4.73	0.896	-0.354	0.906	-0.274	0.947	72.6
0.9000D-01	1.02	-5.46	0.871	-0.390	0.886	-0.299	0.935	71.7
0.100	1.02	-6.23	0.845	-0.423	0.865	-0.321	0.923	70.8
0.200	1.03	-14.9	0.557	-0.638	0.681	-0.458	0.820	62.9
0.300	1.02	-22.6	0.273	-0.718	0.518	-0.546	0.753	57.7
0.400	1.01	-31.2	0.7420D-02	-0.684	0.357	-0.574	0.676	51.8
0.500	0.980	-39.6	-0.186	-0.568	0.223	-0.568	0.610	46.8
0.600	0.950	-47.9	-0.305	-0.420	0.113	-0.534	0.546	41.9
0.700	0.903	-56.3	-0.353	-0.268	0.2940D-01	-0.490	0.491	37.7
0.800	0.856	-64.3	-0.353	-0.138	-0.3370D-01	-0.441	0.443	33.9
0.900	0.793	-72.4	-0.318	-0.3280D-01	-0.8180D-01	-0.394	0.403	30.9
1.00	0.733	-79.2	-0.266	0.3800D-01	-0.119	-0.346	0.366	28.1

TABLE X

RUN ID H-07

. CONTD.

DEAD TIME= 0.480 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.202	-125.	0.984D-02	0.280D-01	-0.141	-0.398D-01	0.146	11.2
3.00	0.186	-77.8	0.201D-02	0.117D-01	-0.591D-01	0.238D-01	0.637D-01	4.89
4.00	0.216	-123.	0.665D-02	0.443D-03	-0.186D-01	0.246D-01	0.308D-01	2.36
5.00	0.134	-83.1	0.165D-02	0.490D-03	-0.214D-02	0.127D-01	0.129D-01	0.988
6.00	0.254	-128.	0.148D-02	-0.108D-02	-0.190D-03	0.722D-02	0.722D-02	0.554
7.00	0.409	-35.0	0.134D-02	0.379D-03	0.216D-02	0.264D-02	0.341D-02	0.262
8.00	1.76	-162.	0.615D-04	-0.166D-02	0.250D-03	0.910D-03	0.943D-03	0.724D-01
9.00	6.49	-173.	-0.112D-02	-0.138D-02	0.198D-03	0.191D-03	0.275D-03	0.211D-01
10.0	0.621	-57.7	-0.204D-03	0.240D-03	-0.502D-03	-0.706D-04	0.507D-03	0.389D-01

TABLE XI

RUN ID H-08

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.886	0.0000D 00	64.7	0.0000D 00	73.0	0.0000D 00	1.00	73.0
0.1000D-02	1.00	0.136D-02	1.00	-0.361D-02	1.00	-0.363D-02	1.00	73.0
0.2000D-02	1.00	0.271D-02	1.00	-0.722D-02	1.00	-0.727D-02	1.00	73.0
0.3000D-02	1.00	0.407D-02	1.00	-0.108D-01	1.00	-0.109D-01	1.00	73.0
0.4000D-02	1.00	0.543D-02	1.00	-0.144D-01	1.00	-0.145D-01	1.00	73.0
0.5000D-02	1.00	0.680D-02	1.00	-0.180D-01	1.00	-0.182D-01	1.00	73.0
0.6000D-02	1.00	0.817D-02	1.00	-0.216D-01	1.00	-0.218D-01	1.00	73.0
0.7000D-02	1.00	0.954D-02	0.999	-0.253D-01	0.999	-0.254D-01	1.00	73.0
0.8000D-02	1.00	0.109D-01	0.999	-0.289D-01	0.999	-0.290D-01	1.00	73.0
0.9000D-02	1.00	0.123D-01	0.999	-0.324D-01	0.999	-0.327D-01	0.999	72.9
0.1000D-01	1.00	0.137D-01	0.999	-0.360D-01	0.999	-0.363D-01	0.999	72.9
0.2000D-01	1.00	0.283D-01	0.995	-0.717D-01	0.995	-0.722D-01	0.997	72.8
0.3000D-01	1.00	0.448D-01	0.988	-0.107	0.988	-0.108	0.994	72.5
0.4000D-01	1.00	0.638D-01	0.979	-0.141	0.979	-0.142	0.990	72.2
0.5000D-01	1.00	0.862D-01	0.968	-0.174	0.968	-0.175	0.984	71.8
0.6000D-01	0.999	0.112	0.955	-0.205	0.955	-0.207	0.977	71.3
0.7000D-01	0.999	0.143	0.940	-0.235	0.940	-0.237	0.970	70.8
0.8000D-01	0.999	0.178	0.924	-0.262	0.924	-0.265	0.961	70.1
0.9000D-01	0.999	0.218	0.906	-0.288	0.906	-0.292	0.952	69.5
0.100	0.999	0.262	0.888	-0.312	0.887	-0.317	0.942	68.7
0.200	1.01	0.709	0.702	-0.470	0.691	-0.475	0.839	61.2
0.300	1.02	0.497	0.536	-0.562	0.520	-0.555	0.760	55.5
0.400	1.03	0.399D-01	0.367	-0.600	0.357	-0.583	0.684	49.9
0.500	1.04	-0.432	0.226	-0.594	0.223	-0.572	0.614	44.8
0.600	1.04	-1.09	0.106	-0.564	0.112	-0.541	0.552	40.3
0.700	1.04	-1.63	0.129D-01	-0.514	0.264D-01	-0.494	0.495	36.1
0.800	1.04	-2.18	-0.566D-01	-0.460	-0.375D-01	-0.444	0.446	32.6
0.900	1.04	-2.72	-0.108	-0.404	-0.657D-01	-0.393	0.403	29.4
1.00	1.04	-3.29	-0.145	-0.349	-0.120	-0.344	0.364	26.6

TABLE XI

RUN ID H-08

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	1.02	-5.07	-0.146	-0.271D-01	-0.140	-0.391D-01	0.145	10.6
3.00	1.03	-8.95	-0.572D-01	0.316D-01	-0.594D-01	0.215D-01	0.632D-01	4.61
4.00	1.11	-11.9	-0.138D-01	0.280D-01	-0.173D-01	0.220D-01	0.280D-01	2.04
5.00	1.07	-24.6	-0.686D-03	0.127D-01	-0.553D-02	0.105D-01	0.119D-01	0.867
6.00	0.942	-28.5	0.126D-02	0.641D-02	-0.207D-02	0.662D-02	0.693D-02	0.506
7.00	0.711	-42.5	0.825D-03	0.220D-02	-0.124D-02	0.307D-02	0.331D-02	0.241
8.00	0.665	-46.8	0.117D-02	0.127D-02	-0.192D-03	0.259D-02	0.260D-02	0.189
9.00	0.568	-23.1	-0.284D-04	0.727D-03	-0.548D-03	0.116D-02	0.128D-02	0.934D-01
10.0	0.663	-3.47	-0.289D-04	0.119D-02	-0.152D-03	0.179D-02	0.180D-02	0.131

TABLE XI CONTD.

RUN ID H-08

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.886	0.0000D 00	64.7	0.0000D 00	73.0	0.0000D 00	1.00	73.0
0.1000D-02	1.00	-0.6170D-01	1.00	-0.4710D-02	1.00	-0.3630D-02	1.00	73.0
0.2000D-02	1.00	-0.123	1.00	-0.9420D-02	1.00	-0.7270D-02	1.00	73.0
0.3000D-02	1.00	-0.185	1.00	-0.1410D-01	1.00	-0.1090D-01	1.00	73.0
0.4000D-02	1.00	-0.247	1.00	-0.1880D-01	1.00	-0.1450D-01	1.00	73.0
0.5000D-02	1.00	-0.308	1.00	-0.2350D-01	1.00	-0.1820D-01	1.00	73.0
0.6000D-02	1.00	-0.370	0.999	-0.2820D-01	1.00	-0.2180D-01	1.00	73.0
0.7000D-02	1.00	-0.432	0.999	-0.3290D-01	0.999	-0.2540D-01	1.00	73.0
0.8000D-02	1.00	-0.493	0.999	-0.3760D-01	0.999	-0.2900D-01	1.00	73.0
0.9000D-02	1.00	-0.555	0.999	-0.4230D-01	0.999	-0.3270D-01	0.999	72.9
0.1000D-01	1.00	-0.617	0.998	-0.4700D-01	0.999	-0.3630D-01	0.999	72.9
0.2000D-01	1.00	-1.23	0.993	-0.9360D-01	0.995	-0.7220D-01	0.997	72.8
0.3000D-01	1.00	-1.85	0.984	-0.139	0.988	-0.108	0.994	72.5
0.4000D-01	1.00	-2.46	0.972	-0.184	0.979	-0.142	0.990	72.2
0.5000D-01	1.00	-3.07	0.957	-0.227	0.968	-0.175	0.984	71.8
0.6000D-01	0.999	-3.67	0.939	-0.267	0.955	-0.207	0.977	71.3
0.7000D-01	0.999	-4.27	0.919	-0.306	0.940	-0.237	0.970	70.8
0.8000D-01	0.999	-4.86	0.897	-0.343	0.924	-0.265	0.961	70.1
0.9000D-01	0.999	-5.45	0.873	-0.377	0.906	-0.292	0.952	69.5
0.100	0.999	-6.04	0.848	-0.408	0.887	-0.317	0.942	68.7
0.200	1.01	-11.9	0.583	-0.612	0.691	-0.475	0.839	61.2
0.300	1.02	-18.4	0.325	-0.705	0.520	-0.555	0.760	55.5
0.400	1.03	-25.2	0.7690D-01	-0.699	0.357	-0.583	0.684	49.9
0.500	1.04	-31.9	-0.117	-0.624	0.223	-0.572	0.614	44.8
0.600	1.04	-38.9	-0.262	-0.511	0.112	-0.541	0.552	40.3
0.700	1.04	-45.7	-0.349	-0.378	0.2640D-01	-0.494	0.495	36.1
0.800	1.04	-52.6	-0.391	-0.250	-0.3750D-01	-0.444	0.446	32.6
0.900	1.04	-59.4	-0.397	-0.131	-0.6570D-01	-0.393	0.403	29.4
1.00	1.04	-66.3	-0.376	-0.2920D-01	-0.120	-0.344	0.364	26.6

TABLE XI

RUN ID H-08.

CONTD.

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	1.02	-131.	0.640D-01	0.134	-0.140	-0.391D-01	0.145	10.6
3.00	1.03	162.	0.515D-01	-0.402D-01	-0.594D-01	0.215D-01	0.632D-01	4.61
4.00	1.11	96.0	-0.224D-01	-0.217D-01	-0.173D-01	0.220D-01	0.280D-01	2.04
5.00	1.07	20.3	-0.946D-02	0.853D-02	-0.553D-02	0.105D-01	0.119D-01	0.867
6.00	0.942	-46.7	0.320D-02	0.570D-02	-0.207D-02	0.662D-02	0.693D-02	0.506
7.00	0.711	-124.	0.230D-02	-0.477D-03	-0.124D-02	0.307D-02	0.331D-02	0.241
8.00	0.665	169.	-0.204D-03	-0.171D-02	-0.192D-03	0.259D-02	0.260D-02	0.189
9.00	0.568	130.	-0.307D-03	-0.659D-03	-0.548D-03	0.116D-02	0.128D-02	0.934D-01
10.0	0.663	86.3	-0.119D-02	-0.237D-04	-0.152D-03	0.179D-02	0.180D-02	0.131

TABLE XII

RUN ID H-09

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.995	0.0000D 00	72.9	0.0000D 00	73.3	0.0000D 00	1.00	73.3
0.1000D-02	1.00	0.1320D-01	1.00	-0.3670D-02	1.00	-0.3900D-02	1.00	73.3
0.2000D-02	1.00	0.2640D-01	1.00	-0.7340D-02	1.00	-0.7800D-02	1.00	73.3
0.3000D-02	1.00	0.3960D-01	1.00	-0.1100D-01	1.00	-0.1170D-01	1.00	73.3
0.4000D-02	1.00	0.5280D-01	1.00	-0.1470D-01	1.00	-0.1560D-01	1.00	73.3
0.5000D-02	1.00	0.6590D-01	1.00	-0.1830D-01	1.00	-0.1950D-01	1.00	73.3
0.6000D-02	1.00	0.7910D-01	0.999	-0.2200D-01	0.999	-0.2340D-01	1.00	73.3
0.7000D-02	1.00	0.9220D-01	0.999	-0.2570D-01	0.999	-0.2730D-01	1.00	73.3
0.8000D-02	1.00	0.105	0.999	-0.2930D-01	0.999	-0.3120D-01	0.999	73.3
0.9000D-02	1.00	0.118	0.999	-0.3300D-01	0.999	-0.3500D-01	0.999	73.3
0.1000D-01	1.00	0.131	0.999	-0.3660D-01	0.998	-0.3890D-01	0.999	73.2
0.2000D-01	1.00	0.259	0.994	-0.7290D-01	0.993	-0.7730D-01	0.996	73.0
0.3000D-01	1.00	0.379	0.987	-0.108	0.985	-0.115	0.992	72.7
0.4000D-01	1.00	0.488	0.978	-0.143	0.974	-0.151	0.986	72.3
0.5000D-01	1.00	0.583	0.966	-0.176	0.960	-0.185	0.978	71.7
0.6000D-01	1.01	0.663	0.952	-0.207	0.945	-0.217	0.969	71.0
0.7000D-01	1.01	0.725	0.937	-0.237	0.927	-0.247	0.959	70.3
0.8000D-01	1.01	0.770	0.919	-0.264	0.908	-0.274	0.948	69.5
0.9000D-01	1.01	0.798	0.901	-0.289	0.888	-0.299	0.937	68.7
0.100	1.01	0.811	0.882	-0.313	0.868	-0.321	0.925	67.8
0.200	1.02	0.932	0.701	-0.462	0.682	-0.466	0.826	60.5
0.300	1.04	1.39	0.541	-0.559	0.509	-0.552	0.751	55.1
0.400	1.05	0.269	0.369	-0.600	0.349	-0.574	0.672	49.3
0.500	1.05	0.181	0.229	-0.592	0.217	-0.567	0.607	44.5
0.600	1.06	-0.469	0.108	-0.564	0.106	-0.533	0.544	39.9
0.700	1.05	-0.840	0.1640D-01	-0.513	0.2280D-01	-0.488	0.489	35.8
0.800	1.06	-1.21	-0.5320D-01	-0.463	-0.4110D-01	-0.439	0.441	32.3
0.900	1.05	-1.89	-0.107	-0.405	-0.8910D-01	-0.388	0.398	29.1
1.00	1.05	-2.14	-0.142	-0.350	-0.123	-0.339	0.360	26.4

TABLE XII

RUN ID H-09

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.03	-2.83	-0.146	-0.296D-01	-0.140	-0.358D-01	0.145	10.6
3.00	1.08	-5.16	-0.585D-01	0.320D-01	-0.568D-01	0.247D-01	0.619D-01	4.54
4.00	1.05	-8.63	-0.145D-01	0.263D-01	-0.174D-01	0.227D-01	0.286D-01	2.09
5.00	1.09	-13.5	-0.230D-02	0.131D-01	-0.487D-02	0.112D-01	0.122D-01	0.896
6.00	0.979	-18.2	0.118D-02	0.735D-02	-0.120D-02	0.751D-02	0.761D-02	0.558
7.00	0.871	-12.7	0.632D-03	0.309D-02	-0.691D-04	0.362D-02	0.362D-02	0.265
8.00	0.846	-24.6	0.121D-02	0.192D-02	0.553D-03	0.266D-02	0.268D-02	0.197
9.00	0.828	6.39	-0.179D-03	0.870D-03	-0.981D-04	0.107D-02	0.107D-02	0.786D-01
10.0	0.677	-15.8	0.575D-03	0.109D-02	0.380D-03	0.178D-02	0.182D-02	0.133

TABLE XII CONTD.

RUN ID H-09

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.995	0.0000D 00	72.9	0.0000D 00	73.3	0.0000D 00	1.00	73.3
0.1000D-02	1.00	-0.498D-01	1.00	-0.477D-02	1.00	-0.390D-02	1.00	73.3
0.2000D-02	1.00	-0.997D-01	1.00	-0.954D-02	1.00	-0.780D-02	1.00	73.3
0.3000D-02	1.00	-0.149	1.00	-0.143D-01	1.00	-0.117D-01	1.00	73.3
0.4000D-02	1.00	-0.199	1.00	-0.191D-01	1.00	-0.156D-01	1.00	73.3
0.5000D-02	1.00	-0.249	1.00	-0.238D-01	1.00	-0.195D-01	1.00	73.3
0.6000D-02	1.00	-0.299	0.999	-0.286D-01	0.999	-0.234D-01	1.00	73.3
0.7000D-02	1.00	-0.349	0.999	-0.334D-01	0.999	-0.273D-01	1.00	73.3
0.8000D-02	1.00	-0.399	0.999	-0.381D-01	0.999	-0.312D-01	0.999	73.3
0.9000D-02	1.00	-0.449	0.998	-0.429D-01	0.999	-0.350D-01	0.999	73.3
0.1000D-01	1.00	-0.499	0.998	-0.476D-01	0.998	-0.389D-01	0.999	73.2
0.2000D-01	1.00	-1.00	0.992	-0.948D-01	0.993	-0.773D-01	0.996	73.0
0.3000D-01	1.00	-1.51	0.983	-0.141	0.985	-0.115	0.992	72.7
0.4000D-01	1.00	-2.03	0.971	-0.186	0.974	-0.151	0.986	72.3
0.5000D-01	1.00	-2.57	0.955	-0.229	0.960	-0.185	0.978	71.7
0.6000D-01	1.01	-3.12	0.936	-0.269	0.945	-0.217	0.969	71.0
0.7000D-01	1.01	-3.69	0.916	-0.308	0.927	-0.247	0.959	70.3
0.8000D-01	1.01	-4.27	0.893	-0.344	0.908	-0.274	0.948	69.5
0.9000D-01	1.01	-4.87	0.868	-0.377	0.888	-0.299	0.937	68.7
0.100	1.01	-5.49	0.843	-0.408	0.868	-0.321	0.925	67.8
0.200	1.02	-11.7	0.583	-0.604	0.682	-0.466	0.826	60.5
0.300	1.04	-17.5	0.331	-0.704	0.509	-0.552	0.751	55.1
0.400	1.05	-24.9	0.783D-01	-0.700	0.349	-0.574	0.672	49.3
0.500	1.05	-31.3	-0.115	-0.625	0.217	-0.567	0.607	44.5
0.600	1.06	-38.3	-0.260	-0.511	0.106	-0.533	0.544	39.9
0.700	1.05	-45.0	-0.345	-0.380	0.228D-01	-0.488	0.489	35.8
0.800	1.06	-51.6	-0.391	-0.254	-0.411D-01	-0.439	0.441	32.3
0.900	1.05	-58.6	-0.397	-0.133	-0.891D-01	-0.388	0.398	29.1
1.00	1.05	-65.2	-0.377	-0.325D-01	-0.123	-0.339	0.360	26.4

TABLE XII

RUN ID H-09

CONTD.

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.03	-129.	0.618D-01	0.135	-0.140	-0.358D-01	0.145	10.6
3.00	1.08	166.	0.527D-01	-0.408D-01	-0.568D-01	0.247D-01	0.619D-01	4.54
4.00	1.05	99.3	-0.206D-01	-0.219D-01	-0.174D-01	0.227D-01	0.286D-01	2.09
5.00	1.09	31.3	-0.109D-01	0.768D-02	-0.487D-02	0.112D-01	0.122D-01	0.896
6.00	0.979	-36.4	0.341D-02	0.662D-02	-0.120D-02	0.751D-02	0.761D-02	0.558
7.00	0.871	-93.8	0.315D-02	-0.151D-03	-0.691D-04	0.362D-02	0.362D-02	0.265
8.00	0.846	-169.	0.144D-03	-0.227D-02	0.353D-03	0.266D-02	0.268D-02	0.197
9.00	0.828	159.	-0.239D-03	-0.856D-03	-0.981D-04	0.107D-02	0.107D-02	0.786D-01
10.0	0.677	73.9	-0.109D-02	0.580D-03	0.380D-03	0.178D-02	0.182D-02	0.133

TABLE XIII

RUN ID H-10

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATL 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.05	0.0000D 00	68.8	0.0000D 00	65.3	0.0000D 00	1.00	65.3
0.1000D-02	1.00	0.965D-02	1.00	-0.302D-02	1.00	-0.318D-02	1.00	65.3
0.2000D-02	1.00	0.193D-01	1.00	-0.603D-02	1.00	-0.637D-02	1.00	65.3
0.3000D-02	1.00	0.289D-01	1.00	-0.904D-02	1.00	-0.955D-02	1.00	65.3
0.4000D-02	1.00	0.386D-01	1.00	-0.121D-01	1.00	-0.127D-01	1.00	65.3
0.5000D-02	1.00	0.482D-01	1.00	-0.151D-01	1.00	-0.159D-01	1.00	65.3
0.6000D-02	1.00	0.579D-01	1.00	-0.181D-01	1.00	-0.191D-01	1.00	65.3
0.7000D-02	1.00	0.675D-01	1.00	-0.211D-01	1.00	-0.223D-01	1.00	65.3
0.8000D-02	1.00	0.771D-01	1.00	-0.241D-01	0.999	-0.255D-01	1.00	65.3
0.9000D-02	1.00	0.867D-01	0.999	-0.271D-01	0.999	-0.286D-01	1.00	65.3
0.1000D-01	1.00	0.963D-01	0.999	-0.301D-01	0.999	-0.318D-01	1.00	65.3
0.2000D-01	1.00	0.192	0.997	-0.601D-01	0.996	-0.634D-01	0.998	65.2
0.3000D-01	1.00	0.285	0.993	-0.899D-01	0.992	-0.947D-01	0.996	65.1
0.4000D-01	1.00	0.375	0.988	-0.119	0.985	-0.126	0.993	64.9
0.5000D-01	1.00	0.460	0.981	-0.148	0.977	-0.156	0.990	64.6
0.6000D-01	1.00	0.541	0.973	-0.177	0.968	-0.185	0.985	64.4
0.7000D-01	1.01	0.615	0.964	-0.204	0.957	-0.213	0.980	64.0
0.8000D-01	1.01	0.681	0.953	-0.231	0.944	-0.241	0.974	63.6
0.9000D-01	1.01	0.740	0.942	-0.257	0.930	-0.267	0.968	63.2
0.100	1.01	0.789	0.929	-0.282	0.916	-0.292	0.961	62.8
0.200	1.03	0.625	0.766	-0.480	0.736	-0.472	0.874	57.1
0.300	1.05	-0.549	0.583	-0.590	0.561	-0.557	0.790	51.6
0.400	1.05	-1.59	0.407	-0.637	0.404	-0.595	0.719	47.0
0.500	1.05	-2.27	0.252	-0.638	0.262	-0.595	0.650	42.5
0.600	1.06	-3.37	0.120	-0.609	0.147	-0.566	0.585	38.2
0.700	1.06	-4.59	0.146D-01	-0.559	0.560D-01	-0.525	0.528	34.5
0.800	1.05	-5.37	-0.624D-01	-0.498	-0.147D-01	-0.477	0.477	31.2
0.900	1.05	-6.16	-0.118	-0.437	-0.740D-01	-0.427	0.432	28.2
1.00	1.04	-6.97	-0.159	-0.378	-0.107	-0.378	0.392	25.6

TABLE XIII

RUN ID H-10

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.00	-11.8	-0.158	-0.232D-01	-0.150	-0.547D-01	0.159	10.4
3.00	0.996	-16.5	-0.590D-01	0.368D-01	-0.673D-01	0.187D-01	0.698D-01	4.56
4.00	1.03	-25.1	-0.121D-01	0.293D-01	-0.227D-01	0.208D-01	0.308D-01	2.01
5.00	0.869	-37.8	-0.234D-03	0.123D-01	-0.888D-02	0.110D-01	0.141D-01	0.923
6.00	0.778	-39.1	0.907D-03	0.608D-02	-0.402D-02	0.680D-02	0.790D-02	0.516
7.00	0.418	-45.0	0.527D-03	0.200D-02	-0.248D-02	0.427D-02	0.494D-02	0.323
8.00	0.738	-12.5	0.410D-04	0.201D-02	-0.534D-03	0.268D-02	0.273D-02	0.178
9.00	1.13	-9.05	-0.747D-03	0.188D-02	-0.913D-03	0.154D-02	0.179D-02	0.117
10.0	1.22	-25.1	0.354D-03	0.202D-02	-0.439D-03	0.162D-02	0.168D-02	0.110

TABLE XIII CONTD.

RUN ID H-10

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 1.20 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.05	0.0000D 00	68.8	0.0000D 00	65.3	0.0000D 00	1.00	65.3
0.1000D-02	1.00	-0.591D-01	1.00	-0.422D-02	1.00	-0.318D-02	1.00	65.3
0.2000D-02	1.00	-0.118	1.00	-0.843D-02	1.00	-0.637D-02	1.00	65.3
0.3000D-02	1.00	-0.177	1.00	-0.126D-01	1.00	-0.955D-02	1.00	65.3
0.4000D-02	1.00	-0.236	1.00	-0.169D-01	1.00	-0.127D-01	1.00	65.3
0.5000D-02	1.00	-0.296	1.00	-0.211D-01	1.00	-0.159D-01	1.00	65.3
0.6000D-02	1.00	-0.355	1.00	-0.253D-01	1.00	-0.191D-01	1.00	65.3
0.7000D-02	1.00	-0.414	0.999	-0.295D-01	1.00	-0.223D-01	1.00	65.3
0.8000D-02	1.00	-0.473	0.999	-0.337D-01	0.999	-0.255D-01	1.00	65.3
0.9000D-02	1.00	-0.532	0.999	-0.379D-01	0.999	-0.286D-01	1.00	65.3
0.1000D-01	1.00	-0.591	0.999	-0.421D-01	0.999	-0.318D-01	1.00	65.3
0.2000D-01	1.00	-1.18	0.995	-0.840D-01	0.996	-0.634D-01	0.998	65.2
0.3000D-01	1.00	-1.78	0.989	-0.126	0.992	-0.947D-01	0.996	65.1
0.4000D-01	1.00	-2.38	0.981	-0.167	0.985	-0.126	0.993	64.9
0.5000D-01	1.00	-2.98	0.971	-0.207	0.977	-0.156	0.990	64.6
0.6000D-01	1.00	-3.58	0.958	-0.246	0.968	-0.185	0.985	64.4
0.7000D-01	1.01	-4.20	0.943	-0.284	0.957	-0.213	0.980	64.0
0.8000D-01	1.01	-4.82	0.927	-0.321	0.944	-0.241	0.974	63.6
0.9000D-01	1.01	-5.45	0.909	-0.357	0.930	-0.267	0.968	63.2
0.100	1.01	-6.09	0.889	-0.391	0.916	-0.292	0.961	62.8
0.200	1.03	-13.1	0.630	-0.648	0.736	-0.472	0.874	57.1
0.300	1.05	-21.2	0.338	-0.757	0.561	-0.557	0.790	51.6
0.400	1.05	-29.1	0.670D-01	-0.753	0.404	-0.595	0.719	47.0
0.500	1.05	-36.6	-0.153	-0.669	0.262	-0.595	0.650	42.5
0.600	1.06	-44.6	-0.311	-0.538	0.147	-0.566	0.585	38.2
0.700	1.06	-52.7	-0.406	-0.384	0.560D-01	-0.525	0.528	34.5
0.800	1.05	-60.4	-0.444	-0.234	-0.147D-01	-0.477	0.477	31.2
0.900	1.05	-68.0	-0.442	-0.102	-0.674D-01	-0.427	0.432	28.2
1.00	1.04	-75.7	-0.410	0.112D-01	-0.107	-0.378	0.392	25.6

TABLE XIII

RUN ID H-10

CONTD.

DEAD TIME= 1.20 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.00	-149.	0.101	0.124	-0.150	-0.547D-01	0.159	10.4
3.00	0.996	137.	0.366D-01	-0.591D-01	-0.673D-01	0.187D-01	0.698D-01	4.56
4.00	1.03	59.9	-0.302D-01	-0.948D-02	-0.227D-01	0.208D-01	0.308D-01	2.01
5.00	0.869	-21.6	-0.366D-02	0.117D-01	-0.888D-02	0.110D-01	0.141D-01	0.923
6.00	0.778	-91.6	0.537D-02	0.298D-02	-0.402D-02	0.680D-02	0.790D-02	0.516
7.00	0.418	-166.	0.143D-02	-0.149D-02	-0.248D-02	0.427D-02	0.494D-02	0.323
8.00	0.738	157.	-0.391D-03	-0.197D-02	-0.534D-03	0.268D-02	0.273D-02	0.178
9.00	1.13	92.2	-0.170D-02	-0.110D-02	-0.913D-03	0.154D-02	0.179D-02	0.117
10.0	1.22	7.38	-0.787D-03	0.190D-02	-0.439D-03	0.162D-02	0.168D-02	0.110

TABLE XIV

RUN ID H-11

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.02	0.0000D 00	66.3	0.0000D 00	64.9	0.0000D 00	1.00	64.9
0.1000D-02	1.00	0.184D-01	1.00	-0.299D-02	1.00	-0.331D-02	1.00	64.9
0.2000D-02	1.00	0.367D-01	1.00	-0.598D-02	1.00	-0.662D-02	1.00	64.9
0.3000D-02	1.00	0.551D-01	1.00	-0.896D-02	1.00	-0.993D-02	1.00	64.9
0.4000D-02	1.00	0.734D-01	1.00	-0.120D-01	1.00	-0.132D-01	1.00	64.9
0.5000D-02	1.00	0.917D-01	1.00	-0.149D-01	1.00	-0.165D-01	1.00	64.9
0.6000D-02	1.00	0.110	1.00	-0.179D-01	1.00	-0.198D-01	1.00	64.9
0.7000D-02	1.00	0.128	1.00	-0.209D-01	1.00	-0.231D-01	1.00	64.9
0.8000D-02	1.00	0.147	0.999	-0.239D-01	0.999	-0.265D-01	1.00	64.9
0.9000D-02	1.00	0.165	0.999	-0.269D-01	0.999	-0.298D-01	1.00	64.9
0.1000D-01	1.00	0.183	0.999	-0.299D-01	0.999	-0.331D-01	1.00	64.9
0.2000D-01	1.00	0.365	0.997	-0.596D-01	0.996	-0.659D-01	0.998	64.8
0.3000D-01	1.00	0.544	0.993	-0.890D-01	0.991	-0.984D-01	0.996	64.7
0.4000D-01	1.00	0.719	0.988	-0.118	0.984	-0.130	0.993	64.5
0.5000D-01	1.00	0.888	0.981	-0.147	0.975	-0.161	0.989	64.2
0.6000D-01	1.00	1.05	0.972	-0.174	0.965	-0.191	0.984	63.9
0.7000D-01	1.01	1.21	0.963	-0.202	0.953	-0.221	0.978	63.5
0.8000D-01	1.01	1.35	0.952	-0.228	0.939	-0.248	0.972	63.1
0.9000D-01	1.01	1.49	0.940	-0.253	0.925	-0.275	0.965	62.7
0.100	1.01	1.61	0.927	-0.278	0.909	-0.300	0.957	62.2
0.200	1.03	2.19	0.767	-0.465	0.724	-0.477	0.867	56.3
0.300	1.05	2.08	0.598	-0.569	0.549	-0.562	0.786	51.0
0.400	1.06	2.06	0.433	-0.624	0.386	-0.601	0.715	46.4
0.500	1.08	1.65	0.279	-0.634	0.242	-0.594	0.642	41.7
0.600	1.08	0.830	0.150	-0.610	0.130	-0.564	0.579	37.6
0.700	1.08	0.416	0.444D-01	-0.567	0.372D-01	-0.524	0.525	34.1
0.800	1.09	0.112	-0.385D-01	-0.513	-0.364D-01	-0.472	0.473	30.7
0.900	1.09	-0.494	-0.998D-01	-0.453	-0.883D-01	-0.418	0.427	27.7
1.00	1.08	-0.964	-0.143	-0.393	-0.126	-0.366	0.387	25.1

TABLE XIV

RUN ID H-11

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.07	2.54	-0.156	-0.452D-01	-0.149	-0.359D-01	0.153	9.92
3.00	1.14	1.38	-0.640D-01	0.274D-01	-0.555D-01	0.254D-01	0.611D-01	3.97
4.00	1.60	-2.43	-0.210D-01	0.302D-01	-0.139D-01	0.183D-01	0.230D-01	1.49
5.00	1.38	-38.4	-0.645D-02	0.113D-01	-0.877D-02	0.353D-02	0.945D-02	0.614
6.00	0.766	-65.9	0.113D-02	0.813D-02	-0.908D-02	0.567D-02	0.107D-01	0.696
7.00	0.344	-26.8	-0.691D-03	0.354D-02	-0.643D-02	0.826D-02	0.105D-01	0.680
8.00	0.374	-10.1	0.103D-02	0.345D-02	0.110D-02	0.956D-02	0.962D-02	0.625
9.00	0.325	130.	-0.200D-02	0.513D-03	0.517D-02	0.370D-02	0.635D-02	0.413
10.0	0.289	39.7	0.138D-02	0.641D-03	0.508D-02	-0.134D-02	0.525D-02	0.341

TABLE XIV CONTD.

RUN ID H-11

COMMENTS HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 1.30 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.02	0.000D 00	66.3	0.000D 00	64.9	0.000D 00	1.00	64.9
0.100D-02	1.00	-0.561D-01	1.00	-0.429D-02	1.00	-0.331D-02	1.00	64.9
0.200D-02	1.00	-0.112	1.00	-0.858D-02	1.00	-0.662D-02	1.00	64.9
0.300D-02	1.00	-0.168	1.00	-0.129D-01	1.00	-0.993D-02	1.00	64.9
0.400D-02	1.00	-0.225	1.00	-0.172D-01	1.00	-0.132D-01	1.00	64.9
0.500D-02	1.00	-0.281	1.00	-0.214D-01	1.00	-0.165D-01	1.00	64.9
0.600D-02	1.00	-0.337	1.00	-0.257D-01	1.00	-0.198D-01	1.00	64.9
0.700D-02	1.00	-0.393	0.999	-0.300D-01	1.00	-0.231D-01	1.00	64.9
0.800D-02	1.00	-0.449	0.999	-0.343D-01	0.999	-0.265D-01	1.00	64.9
0.900D-02	1.00	-0.505	0.999	-0.386D-01	0.999	-0.298D-01	1.00	64.9
0.100D-01	1.00	-0.562	0.999	-0.428D-01	0.999	-0.331D-01	1.00	64.9
0.200D-01	1.00	-1.12	0.995	-0.855D-01	0.996	-0.659D-01	0.998	64.8
0.300D-01	1.00	-1.69	0.989	-0.128	0.991	-0.984D-01	0.996	64.7
0.400D-01	1.00	-2.26	0.980	-0.169	0.984	-0.130	0.993	64.5
0.500D-01	1.00	-2.84	0.969	-0.210	0.975	-0.161	0.989	64.2
0.600D-01	1.00	-3.42	0.956	-0.250	0.965	-0.191	0.984	63.9
0.700D-01	1.01	-4.01	0.941	-0.288	0.953	-0.221	0.978	63.5
0.800D-01	1.01	-4.61	0.923	-0.326	0.939	-0.248	0.972	63.1
0.900D-01	1.01	-5.22	0.904	-0.361	0.925	-0.275	0.965	62.7
0.100	1.01	-5.84	0.884	-0.396	0.909	-0.300	0.957	62.2
0.200	1.03	-12.7	0.622	-0.646	0.724	-0.477	0.867	56.3
0.300	1.05	-20.3	0.336	-0.754	0.549	-0.562	0.786	51.0
0.400	1.06	-27.7	0.658D-01	-0.757	0.386	-0.601	0.715	46.4
0.500	1.08	-35.6	-0.161	-0.674	0.242	-0.594	0.642	41.7
0.600	1.08	-43.9	-0.322	-0.539	0.130	-0.564	0.579	37.6
0.700	1.08	-51.7	-0.421	-0.383	0.372D-01	-0.524	0.525	34.1
0.800	1.09	-59.5	-0.462	-0.226	-0.364D-01	-0.472	0.473	30.7
0.900	1.09	-67.5	-0.456	-0.848D-01	-0.883D-01	-0.418	0.427	27.7
1.00	1.08	-75.4	-0.417	0.329D-01	-0.126	-0.366	0.387	25.1

TABLE XIV

RUN ID H-11

CONTD.

DEAD TIME= 1.30 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	1.07	-146.	0.111	0.119	-0.149	-0.359D-01	0.153	9.92
3.00	1.14	138.	0.276D-01	-0.639D-01	-0.555D-01	0.254D-01	0.611D-01	3.97
4.00	1.60	59.6	-0.365D-01	-0.440D-02	-0.139D-01	0.183D-01	0.230D-01	1.49
5.00	1.38	-50.8	-0.386D-02	0.125D-01	-0.877D-02	0.353D-02	0.945D-02	0.614
6.00	0.766	-153.	0.818D-02	-0.691D-03	-0.908D-02	0.567D-02	0.107D-01	0.696
7.00	0.344	172.	0.178D-02	-0.313D-02	-0.643D-02	0.826D-02	0.105D-01	0.680
8.00	0.374	114.	-0.343D-02	-0.108D-02	0.110D-02	0.956D-02	0.962D-02	0.625
9.00	0.325	180.	-0.169D-02	-0.119D-02	0.517D-02	0.370D-02	0.635D-02	0.413
10.0	0.289	14.9	0.152D-02	0.312D-05	0.508D-02	-0.134D-02	0.525D-02	0.341

TABLE XV

RUN ID H-12

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 2 LINE APP 1/9/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.900	0.0000D 00	64.1	0.0000D 00	71.3	0.0000D 00	1.00	71.3
0.1000D-02	1.00	-0.4100D-01	1.00	-0.436D-02	1.00	-0.365D-02	1.00	71.3
0.2000D-02	1.00	-0.8200D-01	1.00	-0.872D-02	1.00	-0.729D-02	1.00	71.3
0.3000D-02	1.00	-0.123	1.00	-0.131D-01	1.00	-0.109D-01	1.00	71.3
0.4000D-02	1.00	-0.164	1.00	-0.174D-01	1.00	-0.146D-01	1.00	71.2
0.5000D-02	1.00	-0.205	1.00	-0.218D-01	1.00	-0.182D-01	1.00	71.2
0.6000D-02	1.00	-0.246	0.999	-0.262D-01	1.00	-0.219D-01	1.00	71.2
0.7000D-02	1.00	-0.287	0.999	-0.305D-01	0.999	-0.255D-01	1.00	71.2
0.8000D-02	1.00	-0.328	0.999	-0.349D-01	0.999	-0.291D-01	1.00	71.2
0.9000D-02	1.00	-0.369	0.999	-0.392D-01	0.999	-0.328D-01	0.999	71.2
0.1000D-01	1.00	-0.409	0.998	-0.435D-01	0.999	-0.364D-01	0.999	71.2
0.2000D-01	1.00	-0.817	0.993	-0.867D-01	0.995	-0.725D-01	0.997	71.1
0.3000D-01	0.999	-1.22	0.985	-0.129	0.988	-0.108	0.994	70.8
0.4000D-01	0.999	-1.62	0.974	-0.170	0.979	-0.143	0.990	70.5
0.5000D-01	0.999	-2.01	0.960	-0.210	0.968	-0.176	0.984	70.1
0.6000D-01	0.998	-2.40	0.944	-0.248	0.955	-0.208	0.978	69.7
0.7000D-01	0.998	-2.78	0.925	-0.283	0.940	-0.239	0.970	69.1
0.8000D-01	0.997	-3.15	0.905	-0.317	0.923	-0.268	0.961	68.5
0.9000D-01	0.997	-3.51	0.883	-0.349	0.905	-0.295	0.952	67.8
0.100	0.997	-3.86	0.860	-0.378	0.886	-0.320	0.942	67.1
0.200	1.01	-7.58	0.616	-0.564	0.681	-0.475	0.830	59.1
0.300	1.01	-12.8	0.387	-0.649	0.516	-0.541	0.747	53.2
0.400	0.988	-17.7	0.168	-0.649	0.362	-0.574	0.679	48.4
0.500	0.973	-22.1	-0.228D-02	-0.589	0.225	-0.562	0.605	43.1
0.600	0.947	-27.2	-0.126	-0.499	0.123	-0.529	0.544	38.7
0.700	0.910	-31.5	-0.202	-0.398	0.398D-01	-0.489	0.491	35.0
0.800	0.876	-35.9	-0.244	-0.302	-0.235D-01	-0.442	0.443	31.6
0.900	0.832	-39.8	-0.258	-0.214	-0.738D-01	-0.395	0.402	28.6
1.00	0.800	-43.3	-0.252	-0.140	-0.109	-0.344	0.361	25.7

TABLE XV

RUN ID H-12

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.364	-72.6	-0.323D-01	0.436D-01	-0.141	-0.489D-01	0.149	10.6
3.00	0.109	-33.1	-0.443D-02	0.546D-02	-0.614D-01	0.197D-01	0.645D-01	4.60
4.00	0.282	-3.16	-0.539D-02	0.595D-02	-0.202D-01	0.200D-01	0.284D-01	2.03
5.00	0.229	-31.7	-0.214D-03	0.291D-02	-0.748D-02	0.103D-01	0.128D-01	0.909
6.00	0.139	-95.1	0.973D-03	0.446D-03	-0.382D-02	0.670D-02	0.772D-02	0.550
7.00	0.570	66.9	-0.248D-02	-0.471D-03	-0.247D-02	0.368D-02	0.443D-02	0.316
8.00	0.841	-15.6	-0.197D-03	0.191D-02	-0.838D-03	0.213D-02	0.228D-02	0.163
9.00	0.366	-16.0	-0.158D-03	0.775D-03	-0.996D-03	0.192D-02	0.216D-02	0.154
10.0	0.112	-126.	0.207D-03	-0.630D-04	-0.639D-03	0.183D-02	0.193D-02	0.138

TABLE XV CONTD.

RUN ID H-12

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 2 LINE APP 1/9/69

DEAD TIME= 1.80 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.900	0.0000D 00	64.1	0.0000D 00	71.3	0.0000D 00	1.00	71.3
0.1000D-02	1.00	-0.144	1.00	-0.6160D-02	1.00	-0.3650D-02	1.00	71.3
0.2000D-02	1.00	-0.288	1.00	-0.1230D-01	1.00	-0.7290D-02	1.00	71.3
0.3000D-02	1.00	-0.432	1.00	-0.1850D-01	1.00	-0.1090D-01	1.00	71.3
0.4000D-02	1.00	-0.576	1.00	-0.2460D-01	1.00	-0.1460D-01	1.00	71.2
0.5000D-02	1.00	-0.721	0.999	-0.3080D-01	1.00	-0.1820D-01	1.00	71.2
0.6000D-02	1.00	-0.865	0.999	-0.3690D-01	1.00	-0.2190D-01	1.00	71.2
0.7000D-02	1.00	-1.01	0.999	-0.4310D-01	0.999	-0.2550D-01	1.00	71.2
0.8000D-02	1.00	-1.15	0.998	-0.4920D-01	0.999	-0.2910D-01	1.00	71.2
0.9000D-02	1.00	-1.30	0.998	-0.5540D-01	0.999	-0.3280D-01	0.999	71.2
0.1000D-01	1.00	-1.44	0.997	-0.6150D-01	0.999	-0.3640D-01	0.999	71.2
0.2000D-01	1.00	-2.88	0.990	-0.122	0.995	-0.7250D-01	0.997	71.1
0.3000D-01	0.999	-4.32	0.977	-0.182	0.988	-0.108	0.994	70.8
0.4000D-01	0.999	-5.75	0.959	-0.240	0.979	-0.143	0.990	70.5
0.5000D-01	0.999	-7.17	0.938	-0.295	0.968	-0.176	0.984	70.1
0.6000D-01	0.998	-8.59	0.912	-0.348	0.955	-0.208	0.978	69.7
0.7000D-01	0.998	-10.0	0.882	-0.398	0.940	-0.239	0.970	69.1
0.8000D-01	0.997	-11.4	0.850	-0.444	0.923	-0.268	0.961	68.5
0.9000D-01	0.997	-12.8	0.815	-0.486	0.905	-0.295	0.952	67.8
0.100	0.997	-14.2	0.778	-0.525	0.886	-0.320	0.942	67.1
0.200	1.01	-28.2	0.378	-0.744	0.681	-0.475	0.830	59.1
0.300	1.01	-43.8	-0.1600D-02	-0.755	0.516	-0.541	0.747	53.2
0.400	0.988	-59.0	-0.302	-0.599	0.362	-0.574	0.679	48.4
0.500	0.973	-73.7	-0.463	-0.364	0.225	-0.562	0.605	43.1
0.600	0.947	-89.1	-0.499	-0.124	0.123	-0.529	0.544	38.7
0.700	0.910	-104.	-0.441	0.7020D-01	0.3980D-01	-0.489	0.491	35.0
0.800	0.876	-118.	-0.331	0.202	-0.2350D-01	-0.442	0.443	31.6
0.900	0.832	-133.	-0.201	0.268	-0.7380D-01	-0.395	0.402	28.6
1.00	0.800	-146.	-0.7930D-01	0.278	-0.109	-0.344	0.361	25.7

TABLE XV

RUN ID H-12

CONTD.

DEAD TIME= 1.80 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.364	81.1	0.967D-02	-0.534D-01	-0.141	-0.489D-01	0.149	10.6
3.00	0.109	17.5	-0.703D-02	0.435D-04	-0.614D-01	0.197D-01	0.645D-01	4.60
4.00	0.282	-55.7	0.145D-02	0.790D-02	-0.202D-01	0.200D-01	0.284D-01	2.03
5.00	0.229	173.	0.140D-02	-0.257D-02	-0.748D-02	0.103D-01	0.128D-01	0.909
6.00	0.139	6.10	-0.626D-03	0.868D-03	-0.382D-02	0.670D-02	0.772D-02	0.550
7.00	0.570	65.0	-0.250D-02	-0.387D-03	-0.247D-02	0.368D-02	0.443D-02	0.316
8.00	0.841	-121.	0.190D-02	-0.306D-03	-0.838D-03	0.213D-02	0.228D-02	0.163
9.00	0.366	136.	-0.228D-03	-0.758D-03	-0.996D-03	0.192D-02	0.216D-02	0.154
10.0	0.112	-77.6	0.184D-03	0.113D-03	-0.639D-03	0.183D-02	0.193D-02	0.138

ORTRAN ** STOP

TABLE XVI

RUN ID H-13

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 3 LINE APP 1/9/69

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.10	0.000D 00	22.6	0.000D 00	20.6	0.000D 00	1.00	20.6
0.100D-02	1.00	-0.680D-01	1.00	-0.427D-02	1.00	-0.308D-02	1.00	20.6
0.200D-02	1.00	-0.136	1.00	-0.854D-02	1.00	-0.617D-02	1.00	20.6
0.300D-02	1.00	-0.204	1.00	-0.128D-01	1.00	-0.925D-02	1.00	20.6
0.400D-02	1.00	-0.272	1.00	-0.171D-01	1.00	-0.123D-01	1.00	20.6
0.500D-02	1.00	-0.340	1.00	-0.213D-01	1.00	-0.154D-01	1.00	20.6
0.600D-02	1.00	-0.408	1.00	-0.256D-01	1.00	-0.185D-01	1.00	20.6
0.700D-02	1.00	-0.476	0.999	-0.299D-01	1.00	-0.216D-01	1.00	20.6
0.800D-02	1.00	-0.544	0.999	-0.341D-01	0.999	-0.247D-01	1.00	20.6
0.900D-02	1.00	-0.612	0.999	-0.384D-01	0.999	-0.277D-01	1.00	20.6
0.100D-01	1.00	-0.680	0.999	-0.427D-01	0.999	-0.308D-01	1.00	20.6
0.200D-01	1.00	-1.36	0.995	-0.851D-01	0.997	-0.615D-01	0.999	20.6
0.300D-01	1.00	-2.04	0.988	-0.127	0.993	-0.919D-01	0.997	20.5
0.400D-01	1.00	-2.72	0.980	-0.168	0.987	-0.122	0.994	20.5
0.500D-01	1.00	-3.40	0.968	-0.209	0.979	-0.151	0.991	20.4
0.600D-01	0.999	-4.08	0.955	-0.248	0.971	-0.180	0.987	20.3
0.700D-01	0.999	-4.76	0.939	-0.287	0.961	-0.208	0.983	20.3
0.800D-01	0.999	-5.44	0.922	-0.324	0.949	-0.235	0.978	20.1
0.900D-01	0.999	-6.12	0.902	-0.359	0.936	-0.261	0.972	20.0
0.100	0.998	-6.80	0.881	-0.393	0.923	-0.286	0.966	19.9
0.200	0.993	-13.6	0.614	-0.632	0.751	-0.473	0.887	18.3
0.300	0.987	-20.3	0.336	-0.720	0.572	-0.566	0.805	16.6
0.400	0.981	-27.2	0.860D-01	-0.714	0.411	-0.607	0.733	15.1
0.500	0.968	-34.6	-0.123	-0.632	0.266	-0.609	0.665	13.7
0.600	0.942	-42.0	-0.265	-0.500	0.147	-0.583	0.601	12.4
0.700	0.912	-48.8	-0.341	-0.361	0.509D-01	-0.543	0.545	11.2
0.800	0.887	-55.4	-0.373	-0.229	-0.262D-01	-0.493	0.493	10.2
0.900	0.859	-62.5	-0.366	-0.110	-0.832D-01	-0.438	0.445	9.18
1.00	0.824	-69.3	-0.332	-0.159D-01	-0.124	-0.384	0.403	8.31

TABLE XVI

RUN ID H-13

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.468	-140.	0.406D-01	0.649D-01	-0.156	-0.505D-01	0.164	3.37
3.00	0.303	141.	0.101D-01	-0.177D-01	-0.625D-01	0.249D-01	0.673D-01	1.39
4.00	0.237	58.2	-0.785D-02	-0.685D-03	-0.199D-01	0.266D-01	0.332D-01	0.684
5.00	0.408	-17.3	-0.147D-02	0.520D-02	-0.722D-02	0.111D-01	0.132D-01	0.273
6.00	0.421	-81.6	0.268D-02	0.873D-03	-0.112D-02	0.659D-02	0.669D-02	0.138
7.00	0.775	-180.	0.150D-03	-0.295D-02	-0.190D-03	0.381D-02	0.382D-02	0.786D-01
8.00	0.264	104.	-0.866D-03	-0.441D-03	-0.798D-03	0.359D-02	0.368D-02	0.758D-01
9.00	0.873	-11.6	-0.124D-02	0.851D-03	-0.159D-02	0.671D-03	0.172D-02	0.355D-01
10.0	0.228	-22.0	0.160D-03	0.250D-03	0.240D-03	0.128D-02	0.130D-02	0.268D-01

TABLE XVI CONTD.

RUN ID H-13

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 3 LINE APP 1/9/69

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.10	0.0000D 00	22.6	0.0000D 00	20.6	0.0000D 00	1.00	20.6
0.1000D-02	1.00	-0.114	1.00	-0.507D-02	1.00	-0.308D-02	1.00	20.6
0.2000D-02	1.00	-0.228	1.00	-0.101D-01	1.00	-0.617D-02	1.00	20.6
0.3000D-02	1.00	-0.341	1.00	-0.152D-01	1.00	-0.925D-02	1.00	20.6
0.4000D-02	1.00	-0.455	1.00	-0.203D-01	1.00	-0.123D-01	1.00	20.6
0.5000D-02	1.00	-0.569	1.00	-0.253D-01	1.00	-0.154D-01	1.00	20.6
0.6000D-02	1.00	-0.683	0.999	-0.304D-01	1.00	-0.185D-01	1.00	20.6
0.7000D-02	1.00	-0.797	0.999	-0.355D-01	1.00	-0.216D-01	1.00	20.6
0.8000D-02	1.00	-0.910	0.999	-0.405D-01	0.999	-0.247D-01	1.00	20.6
0.9000D-02	1.00	-1.02	0.999	-0.456D-01	0.999	-0.277D-01	1.00	20.6
0.1000D-01	1.00	-1.14	0.998	-0.506D-01	0.999	-0.308D-01	1.00	20.6
0.2000D-01	1.00	-2.28	0.993	-0.101	0.997	-0.615D-01	0.999	20.6
0.3000D-01	1.00	-3.41	0.985	-0.151	0.993	-0.919D-01	0.997	20.5
0.4000D-01	1.00	-4.55	0.974	-0.200	0.987	-0.122	0.994	20.5
0.5000D-01	1.00	-5.69	0.959	-0.247	0.979	-0.151	0.991	20.4
0.6000D-01	0.999	-6.83	0.942	-0.294	0.971	-0.180	0.987	20.3
0.7000D-01	0.999	-7.97	0.922	-0.339	0.961	-0.208	0.983	20.3
0.8000D-01	0.999	-9.11	0.899	-0.382	0.949	-0.235	0.978	20.1
0.9000D-01	0.999	-10.2	0.874	-0.423	0.936	-0.261	0.972	20.0
0.100	0.998	-11.4	0.847	-0.462	0.923	-0.286	0.966	19.9
0.200	0.993	-22.7	0.506	-0.722	0.751	-0.473	0.887	18.3
0.300	0.987	-34.0	0.155	-0.779	0.572	-0.566	0.805	16.6
0.400	0.981	-45.5	-0.143	-0.705	0.411	-0.607	0.733	15.1
0.500	0.968	-57.5	-0.359	-0.534	0.266	-0.609	0.665	13.7
0.600	0.942	-69.5	-0.466	-0.322	0.147	-0.583	0.601	12.4
0.700	0.912	-80.8	-0.481	-0.125	0.509D-01	-0.543	0.545	11.2
0.800	0.887	-92.1	-0.436	0.393D-01	-0.262D-01	-0.493	0.493	10.2
0.900	0.859	-104.	-0.348	0.159	-0.832D-01	-0.438	0.445	9.18
1.00	0.824	-115.	-0.243	0.227	-0.124	-0.384	0.403	8.31

TABLE XVI

RUN ID H-13

CONTD.

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.468	128.	0.637D-01	-0.425D-01	-0.156	-0.505D-01	0.164	3.37
3.00	0.303	3.91	-0.194D-01	0.623D-02	-0.625D-01	0.249D-01	0.673D-01	1.39
4.00	0.237	-125.	0.787D-02	0.226D-03	-0.199D-01	0.266D-01	0.332D-01	0.684
5.00	0.408	114.	-0.298D-02	-0.451D-02	-0.722D-02	0.111D-01	0.132D-01	0.273
6.00	0.421	3.40	-0.636D-03	0.274D-02	-0.112D-02	0.659D-02	0.669D-02	0.138
7.00	0.775	-141.	0.198D-02	-0.219D-02	-0.190D-03	0.381D-02	0.382D-02	0.786D-01
8.00	0.264	97.8	-0.912D-03	-0.337D-03	-0.798D-03	0.359D-02	0.368D-02	0.758D-01
9.00	0.873	-64.1	-0.774D-04	0.150D-02	-0.159D-02	0.671D-03	0.172D-02	0.355D-01
10.0	0.228	-120.	0.224D-03	-0.194D-03	0.240D-03	0.128D-02	0.130D-02	0.268D-01

TABLE XVII

RUN ID H-14

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 3 LINE APP 1/9/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.927	0.0000D 00	21.4	0.0000D 00	23.1	0.0000D 00	1.00	23.1
0.1000D-02	1.00	-0.5540D-01	1.00	-0.4120D-02	1.00	-0.3160D-02	1.00	23.1
0.2000D-02	1.00	-0.111	1.00	-0.8240D-02	1.00	-0.6310D-02	1.00	23.1
0.3000D-02	1.00	-0.166	1.00	-0.1240D-01	1.00	-0.9470D-02	1.00	23.1
0.4000D-02	1.00	-0.221	1.00	-0.1650D-01	1.00	-0.1260D-01	1.00	23.1
0.5000D-02	1.00	-0.277	1.00	-0.2060D-01	1.00	-0.1580D-01	1.00	23.1
0.6000D-02	1.00	-0.332	1.00	-0.2470D-01	1.00	-0.1890D-01	1.00	23.1
0.7000D-02	1.00	-0.388	0.999	-0.2880D-01	1.00	-0.2210D-01	1.00	23.1
0.8000D-02	1.00	-0.443	0.999	-0.3300D-01	0.999	-0.2520D-01	1.00	23.1
0.9000D-02	1.00	-0.498	0.999	-0.3710D-01	0.999	-0.2840D-01	1.00	23.1
0.1000D-01	1.00	-0.554	0.999	-0.4120D-01	0.999	-0.3150D-01	1.00	23.1
0.2000D-01	1.00	-1.11	0.995	-0.8220D-01	0.996	-0.6290D-01	0.998	23.1
0.3000D-01	1.00	-1.66	0.989	-0.123	0.992	-0.9400D-01	0.996	23.0
0.4000D-01	1.00	-2.22	0.981	-0.163	0.986	-0.125	0.994	23.0
0.5000D-01	1.00	-2.78	0.970	-0.202	0.978	-0.155	0.990	22.9
0.6000D-01	1.00	-3.34	0.957	-0.240	0.969	-0.184	0.986	22.8
0.7000D-01	1.00	-3.90	0.942	-0.277	0.958	-0.212	0.981	22.7
0.8000D-01	1.00	-4.47	0.925	-0.313	0.946	-0.239	0.976	22.6
0.9000D-01	1.00	-5.03	0.907	-0.347	0.933	-0.266	0.970	22.4
0.100	1.00	-5.61	0.886	-0.380	0.918	-0.291	0.963	22.3
0.200	1.00	-11.6	0.631	-0.614	0.741	-0.475	0.880	20.4
0.300	0.989	-17.8	0.360	-0.702	0.563	-0.565	0.798	18.4
0.400	0.970	-23.9	0.119	-0.695	0.402	-0.605	0.727	16.8
0.500	0.949	-29.9	-0.7530D-01	-0.617	0.255	-0.604	0.656	15.2
0.600	0.923	-36.2	-0.208	-0.501	0.138	-0.571	0.588	13.6
0.700	0.884	-42.6	-0.285	-0.374	0.4880D-01	-0.530	0.532	12.3
0.800	0.839	-48.4	-0.316	-0.253	-0.2410D-01	-0.482	0.482	11.1
0.900	0.799	-53.9	-0.314	-0.151	-0.7850D-01	-0.429	0.436	10.1
1.00	0.756	-60.0	-0.292	-0.6640D-01	-0.117	-0.378	0.396	9.15

TABLE XVII

RUN ID H-14

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.246	-111.	0.276D-02	0.402D-01	-0.157	-0.466D-01	0.163	3.78
3.00	0.137	25.3	-0.958D-02	-0.545D-03	-0.648D-01	0.262D-01	0.698D-01	1.61
4.00	0.331	-26.0	-0.254D-02	0.104D-01	-0.207D-01	0.248D-01	0.323D-01	0.747
5.00	0.338	-86.6	0.416D-02	0.244D-02	-0.649D-02	0.127D-01	0.143D-01	0.330
6.00	0.307	-161.	0.156D-02	-0.222D-02	-0.237D-02	0.853D-02	0.885D-02	0.205
7.00	0.625	116.	-0.256D-02	-0.138D-02	-0.195D-03	0.465D-02	0.465D-02	0.107
8.00	0.585	45.0	-0.104D-02	0.152D-02	0.582D-03	0.309D-02	0.315D-02	0.728D-01
9.00	0.766	-63.1	0.125D-02	0.856D-03	-0.256D-03	0.196D-02	0.198D-02	0.458D-01
10.0	0.442	-175.	0.889D-04	-0.852D-03	-0.172D-04	0.194D-02	0.194D-02	0.448D-01

TABLE XVII CONTD.

RUN ID H-14

COMMENTS HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 3 LINE APP 1/9/69

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.927	0.0000D 00	21.4	0.0000D 00	23.1	0.0000D 00	1.00	23.1
0.1000D-02	1.00	-0.101	1.00	-0.4920D-02	1.00	-0.3160D-02	1.00	23.1
0.2000D-02	1.00	-0.202	1.00	-0.9840D-02	1.00	-0.6310D-02	1.00	23.1
0.3000D-02	1.00	-0.304	1.00	-0.1480D-01	1.00	-0.9470D-02	1.00	23.1
0.4000D-02	1.00	-0.405	1.00	-0.1970D-01	1.00	-0.1260D-01	1.00	23.1
0.5000D-02	1.00	-0.506	1.00	-0.2460D-01	1.00	-0.1580D-01	1.00	23.1
0.6000D-02	1.00	-0.607	0.999	-0.2950D-01	1.00	-0.1890D-01	1.00	23.1
0.7000D-02	1.00	-0.708	0.999	-0.3440D-01	1.00	-0.2210D-01	1.00	23.1
0.8000D-02	1.00	-0.810	0.999	-0.3940D-01	0.999	-0.2520D-01	1.00	23.1
0.9000D-02	1.00	-0.911	0.999	-0.4430D-01	0.999	-0.2840D-01	1.00	23.1
0.1000D-01	1.00	-1.01	0.998	-0.4920D-01	0.999	-0.3150D-01	1.00	23.1
0.2000D-01	1.00	-2.02	0.994	-0.9810D-01	0.996	-0.6290D-01	0.998	23.1
0.3000D-01	1.00	-3.04	0.986	-0.146	0.992	-0.9400D-01	0.996	23.0
0.4000D-01	1.00	-4.05	0.975	-0.194	0.986	-0.125	0.994	23.0
0.5000D-01	1.00	-5.07	0.961	-0.240	0.978	-0.155	0.990	22.9
0.6000D-01	1.00	-6.09	0.944	-0.286	0.969	-0.184	0.986	22.8
0.7000D-01	1.00	-7.11	0.925	-0.329	0.958	-0.212	0.981	22.7
0.8000D-01	1.00	-8.13	0.903	-0.371	0.946	-0.239	0.976	22.6
0.9000D-01	1.00	-9.16	0.879	-0.411	0.933	-0.266	0.970	22.4
0.100	1.00	-10.2	0.853	-0.449	0.918	-0.291	0.963	22.3
0.200	1.00	-20.7	0.525	-0.707	0.741	-0.475	0.880	20.4
0.300	0.989	-31.5	0.183	-0.768	0.563	-0.565	0.798	18.4
0.400	0.970	-42.2	-0.106	-0.697	0.402	-0.605	0.727	16.8
0.500	0.949	-52.8	-0.310	-0.539	0.255	-0.604	0.656	15.2
0.600	0.923	-63.7	-0.416	-0.348	0.138	-0.571	0.588	13.6
0.700	0.884	-74.7	-0.440	-0.165	0.488D-01	-0.530	0.532	12.3
0.800	0.839	-85.0	-0.404	-0.147D-01	-0.241D-01	-0.482	0.482	11.1
0.900	0.799	-95.2	-0.335	0.934D-01	-0.785D-01	-0.429	0.436	10.1
1.00	0.756	-106.	-0.251	0.163	-0.117	-0.378	0.396	9.15

TABLE XVII

RUN ID H-14

CONTD.

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.246	158.	0.401D-01	-0.393D-02	-0.157	-0.466D-01	0.163	3.78
3.00	0.137	-112.	0.670D-02	0.687D-02	-0.648D-01	0.262D-01	0.698D-01	1.61
4.00	0.331	151.	0.193D-02	-0.105D-01	-0.207D-01	0.248D-01	0.323D-01	0.747
5.00	0.338	44.2	-0.457D-02	0.155D-02	-0.649D-02	0.127D-01	0.143D-01	0.330
6.00	0.307	-75.5	0.235D-02	0.136D-02	-0.237D-02	0.853D-02	0.885D-02	0.205
7.00	0.625	155.	-0.111D-02	-0.269D-02	-0.195D-03	0.465D-02	0.465D-02	0.107
8.00	0.585	38.4	-0.856D-03	0.163D-02	0.582D-03	0.309D-02	0.315D-02	0.728D-01
9.00	0.766	-116.	0.144D-02	-0.473D-03	-0.256D-03	0.196D-02	0.198D-02	0.458D-01
10.0	0.442	87.1	-0.856D-03	0.361D-04	-0.172D-04	0.194D-02	0.194D-02	0.448D-01

TABLE XVIII

RUN ID H-15

COMMENTS HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 2 LINE APP 1/22/69

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.09	0.000D 00	59.0	0.000D 00	54.3	0.000D 00	1.00	54.3
0.100D-02	1.00	-0.235D-01	1.00	-0.348D-02	1.00	-0.307D-02	1.00	54.3
0.200D-02	1.00	-0.470D-01	1.00	-0.695D-02	1.00	-0.613D-02	1.00	54.3
0.300D-02	1.00	-0.705D-01	1.00	-0.104D-01	1.00	-0.920D-02	1.00	54.3
0.400D-02	1.00	-0.940D-01	1.00	-0.139D-01	1.00	-0.123D-01	1.00	54.3
0.500D-02	1.00	-0.118	1.00	-0.174D-01	1.00	-0.153D-01	1.00	54.3
0.600D-02	1.00	-0.141	1.00	-0.209D-01	1.00	-0.184D-01	1.00	54.3
0.700D-02	1.00	-0.165	1.00	-0.243D-01	1.00	-0.215D-01	1.00	54.3
0.800D-02	1.00	-0.188	0.999	-0.278D-01	0.999	-0.245D-01	1.00	54.3
0.900D-02	1.00	-0.212	0.999	-0.313D-01	0.999	-0.276D-01	1.00	54.3
0.100D-01	1.00	-0.235	0.999	-0.347D-01	0.999	-0.306D-01	1.00	54.3
0.200D-01	1.00	-0.471	0.996	-0.694D-01	0.997	-0.612D-01	0.999	54.2
0.300D-01	1.00	-0.707	0.992	-0.104	0.993	-0.914D-01	0.997	54.1
0.400D-01	1.00	-0.945	0.986	-0.138	0.987	-0.121	0.995	54.0
0.500D-01	1.00	-1.18	0.978	-0.171	0.981	-0.151	0.992	53.9
0.600D-01	1.00	-1.43	0.969	-0.204	0.972	-0.180	0.989	53.7
0.700D-01	1.00	-1.67	0.958	-0.236	0.962	-0.208	0.985	53.5
0.800D-01	1.00	-1.92	0.946	-0.268	0.951	-0.235	0.980	53.2
0.900D-01	1.00	-2.17	0.932	-0.298	0.939	-0.262	0.975	52.9
0.100	1.00	-2.42	0.917	-0.328	0.926	-0.288	0.969	52.6
0.200	1.02	-5.30	0.712	-0.560	0.749	-0.483	0.891	48.4
0.300	1.03	-8.97	0.472	-0.671	0.556	-0.573	0.798	43.4
0.400	1.03	-13.3	0.250	-0.690	0.391	-0.598	0.715	38.8
0.500	1.01	-17.6	0.640D-01	-0.645	0.254	-0.591	0.644	35.0
0.600	0.979	-21.5	-0.732D-01	-0.561	0.141	-0.560	0.578	31.4
0.700	0.948	-25.2	-0.162	-0.464	0.539D-01	-0.515	0.518	28.1
0.800	0.911	-28.6	-0.213	-0.370	-0.108D-01	-0.468	0.468	25.4
0.900	0.870	-31.7	-0.238	-0.284	-0.620D-01	-0.421	0.426	23.1
1.00	0.830	-34.4	-0.244	-0.208	-0.101	-0.373	0.387	21.0

TABLE XVIII

RUN ID H-15

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.500	-42.3	-0.730D-01	0.277D-01	-0.145	-0.572D-01	0.156	8.48
3.00	0.423	-31.9	-0.201D-01	0.193D-01	-0.644D-01	0.136D-01	0.659D-01	3.58
4.00	0.498	-32.1	-0.555D-02	0.142D-01	-0.246D-01	0.182D-01	0.306D-01	1.66
5.00	0.447	-52.4	0.982D-03	0.605D-02	-0.939D-02	0.999D-02	0.137D-01	0.744
6.00	0.337	-59.4	0.124D-02	0.217D-02	-0.367D-02	0.645D-02	0.742D-02	0.403
7.00	0.217	67.9	-0.102D-02	-0.249D-03	-0.282D-02	0.391D-02	0.482D-02	0.262
8.00	0.705	2.94	-0.712D-03	0.178D-02	-0.879D-03	0.257D-02	0.272D-02	0.148
9.00	0.738	-63.4	0.947D-04	0.143D-02	-0.168D-02	0.984D-03	0.195D-02	0.106
10.0	0.449	-58.2	0.573D-03	0.881D-03	-0.998D-03	0.212D-02	0.234D-02	0.127

TABLE XVIII CONTD.

RUN ID H-15

COMMENTS HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 2 LINE APP 1/22/69

DEAD TIME= 0.900 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.09	0.0000D 00	59.0	0.0000D 00	54.3	0.0000D 00	1.00	54.3
0.1000D-02	1.00	-0.7510D-01	1.00	-0.438D-02	1.00	-0.307D-02	1.00	54.3
0.2000D-02	1.00	-0.150	1.00	-0.875D-02	1.00	-0.613D-02	1.00	54.3
0.3000D-02	1.00	-0.225	1.00	-0.131D-01	1.00	-0.920D-02	1.00	54.3
0.4000D-02	1.00	-0.300	1.00	-0.175D-01	1.00	-0.123D-01	1.00	54.3
0.5000D-02	1.00	-0.375	1.00	-0.219D-01	1.00	-0.153D-01	1.00	54.3
0.6000D-02	1.00	-0.450	1.00	-0.263D-01	1.00	-0.184D-01	1.00	54.3
0.7000D-02	1.00	-0.526	0.999	-0.306D-01	1.00	-0.215D-01	1.00	54.3
0.8000D-02	1.00	-0.601	0.999	-0.350D-01	0.999	-0.245D-01	1.00	54.3
0.9000D-02	1.00	-0.676	0.999	-0.394D-01	0.999	-0.276D-01	1.00	54.3
0.1000D-01	1.00	-0.751	0.999	-0.437D-01	0.999	-0.306D-01	1.00	54.3
0.2000D-01	1.00	-1.50	0.995	-0.873D-01	0.997	-0.612D-01	0.999	54.2
0.3000D-01	1.00	-2.25	0.989	-0.130	0.993	-0.914D-01	0.997	54.1
0.4000D-01	1.00	-3.01	0.980	-0.173	0.987	-0.121	0.995	54.0
0.5000D-01	1.00	-3.76	0.970	-0.215	0.981	-0.151	0.992	53.9
0.6000D-01	1.00	-4.52	0.957	-0.256	0.972	-0.180	0.989	53.7
0.7000D-01	1.00	-5.28	0.941	-0.296	0.962	-0.208	0.985	53.5
0.8000D-01	1.00	-6.04	0.924	-0.335	0.951	-0.235	0.980	53.2
0.9000D-01	1.00	-6.81	0.905	-0.373	0.939	-0.262	0.975	52.9
0.100	1.00	-7.58	0.884	-0.409	0.926	-0.288	0.969	52.6
0.200	1.02	-15.6	0.601	-0.678	0.749	-0.483	0.891	48.4
0.300	1.03	-24.4	0.276	-0.772	0.556	-0.573	0.798	43.4
0.400	1.03	-33.9	-0.942D-02	-0.733	0.391	-0.598	0.715	38.8
0.500	1.01	-43.4	-0.223	-0.609	0.254	-0.591	0.644	35.0
0.600	0.979	-52.5	-0.351	-0.444	0.141	-0.560	0.578	31.4
0.700	0.948	-61.3	-0.404	-0.280	0.539D-01	-0.515	0.518	28.1
0.800	0.911	-69.9	-0.404	-0.137	-0.108D-01	-0.468	0.468	25.4
0.900	0.870	-78.1	-0.370	-0.229D-01	-0.620D-01	-0.421	0.426	23.1
1.00	0.830	-85.9	-0.315	0.618D-01	-0.101	-0.373	0.387	21.0

TABLE XVIII

RUN ID H-15

CONTD.

DEAD TIME= 0.900 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.500	-145.	0.435D-01	0.648D-01	-0.145	-0.572D-01	0.156	8.48
3.00	0.423	173.	0.264D-01	-0.886D-02	-0.644D-01	0.136D-01	0.659D-01	3.58
4.00	0.498	122.	-0.130D-02	-0.152D-01	-0.246D-01	0.182D-01	0.306D-01	1.66
5.00	0.447	49.7	-0.612D-02	-0.315D-03	-0.939D-02	0.999D-02	0.137D-01	0.744
6.00	0.337	-8.79	-0.892D-03	0.234D-02	-0.367D-02	0.645D-02	0.742D-02	0.403
7.00	0.217	67.0	-0.102D-02	-0.232D-03	-0.282D-02	0.391D-02	0.482D-02	0.262
8.00	0.705	-49.6	0.980D-03	0.165D-02	-0.879D-03	0.257D-02	0.272D-02	0.148
9.00	0.738	-168.	0.137D-02	-0.441D-03	-0.168D-02	0.984D-03	0.195D-02	0.106
10.0	0.449	146.	-0.159D-03	-0.104D-02	-0.998D-03	0.212D-02	0.234D-02	0.127

TABLE XIX

RUN ID H-17

COMMENTS HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 3 LINE APP 1/22/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.924	0.0000D 00	18.9	0.0000D 00	20.5	0.0000D 00	1.00	20.5
0.1000D-02	1.00	-0.2500D-01	1.00	-0.343D-02	1.00	-0.299D-02	1.00	20.5
0.2000D-02	1.00	-0.5000D-01	1.00	-0.685D-02	1.00	-0.598D-02	1.00	20.5
0.3000D-02	1.00	-0.7490D-01	1.00	-0.103D-01	1.00	-0.897D-02	1.00	20.5
0.4000D-02	1.00	-0.9990D-01	1.00	-0.137D-01	1.00	-0.120D-01	1.00	20.5
0.5000D-02	1.00	-0.125	1.00	-0.171D-01	1.00	-0.150D-01	1.00	20.5
0.6000D-02	1.00	-0.150	1.00	-0.206D-01	1.00	-0.179D-01	1.00	20.5
0.7000D-02	1.00	-0.175	1.00	-0.240D-01	1.00	-0.209D-01	1.00	20.5
0.8000D-02	1.00	-0.200	0.999	-0.274D-01	1.00	-0.239D-01	1.00	20.5
0.9000D-02	1.00	-0.225	0.999	-0.308D-01	1.00	-0.269D-01	1.00	20.5
0.1000D-01	1.00	-0.250	0.999	-0.343D-01	0.999	-0.299D-01	1.00	20.5
0.2000D-01	1.00	-0.501	0.997	-0.684D-01	0.997	-0.597D-01	0.999	20.4
0.3000D-01	1.00	-0.754	0.993	-0.102	0.993	-0.892D-01	0.997	20.4
0.4000D-01	1.00	-1.01	0.987	-0.136	0.988	-0.118	0.995	20.4
0.5000D-01	1.00	-1.27	0.980	-0.169	0.981	-0.147	0.992	20.3
0.6000D-01	1.00	-1.54	0.971	-0.202	0.973	-0.175	0.989	20.2
0.7000D-01	1.00	-1.81	0.961	-0.234	0.964	-0.203	0.985	20.1
0.8000D-01	1.01	-2.09	0.949	-0.265	0.953	-0.229	0.980	20.1
0.9000D-01	1.01	-2.38	0.936	-0.296	0.941	-0.255	0.975	19.9
0.100	1.01	-2.68	0.921	-0.326	0.928	-0.280	0.970	19.8
0.200	1.02	-6.22	0.721	-0.565	0.761	-0.472	0.895	18.3
0.300	1.03	-10.6	0.477	-0.684	0.577	-0.568	0.810	16.6
0.400	1.02	-14.8	0.249	-0.703	0.413	-0.605	0.732	15.0
0.500	1.01	-18.6	0.636D-01	-0.662	0.270	-0.602	0.660	13.5
0.600	0.998	-22.8	-0.789D-01	-0.585	0.154	-0.571	0.591	12.1
0.700	0.977	-27.2	-0.179	-0.489	0.656D-01	-0.529	0.533	10.9
0.800	0.944	-31.1	-0.239	-0.389	-0.432D-02	-0.484	0.484	9.89
0.900	0.913	-34.3	-0.268	-0.297	-0.591D-01	-0.434	0.438	8.96
1.00	0.886	-37.6	-0.277	-0.217	-0.985D-01	-0.385	0.397	8.13

TABLE XIX

RUN ID H-17

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.630	-61.4	-0.792D-01	0.627D-01	-0.148	-0.625D-01	0.160	3.28
3.00	0.487	-79.4	-0.912D-03	0.334D-01	-0.679D-01	0.107D-01	0.687D-01	1.41
4.00	0.396	-98.9	0.868D-02	0.888D-02	-0.256D-01	0.182D-01	0.314D-01	0.642
5.00	0.239	-137.	0.354D-02	0.572D-04	-0.111D-01	0.985D-02	0.148D-01	0.303
6.00	0.341	-158.	0.256D-02	-0.129D-02	-0.556D-02	0.628D-02	0.839D-02	0.172
7.00	0.470	118.	-0.702D-03	-0.239D-02	-0.377D-02	0.374D-02	0.531D-02	0.109
8.00	0.515	62.6	-0.150D-02	0.208D-03	-0.982D-03	0.277D-02	0.294D-02	0.602D-01
9.00	0.264	19.0	-0.489D-03	0.218D-03	-0.149D-02	0.139D-02	0.203D-02	0.416D-01
10.0	0.260	22.0	-0.374D-03	0.363D-03	-0.810D-03	0.183D-02	0.200D-02	0.410D-01

TABLE XIX CONTD.

RUN ID H-17

COMMENTS HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 3 LINE APP 1/22/69

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.924	0.0000D 00	18.9	0.0000D 00	20.5	0.0000D 00	1.00	20.5
0.1000D-02	1.00	-0.708D-01	1.00	-0.423D-02	1.00	-0.299D-02	1.00	20.5
0.2000D-02	1.00	-0.142	1.00	-0.845D-02	1.00	-0.598D-02	1.00	20.5
0.3000D-02	1.00	-0.212	1.00	-0.127D-01	1.00	-0.897D-02	1.00	20.5
0.4000D-02	1.00	-0.283	1.00	-0.169D-01	1.00	-0.120D-01	1.00	20.5
0.5000D-02	1.00	-0.354	1.00	-0.211D-01	1.00	-0.150D-01	1.00	20.5
0.6000D-02	1.00	-0.425	1.00	-0.254D-01	1.00	-0.179D-01	1.00	20.5
0.7000D-02	1.00	-0.496	0.999	-0.296D-01	1.00	-0.209D-01	1.00	20.5
0.8000D-02	1.00	-0.567	0.999	-0.338D-01	1.00	-0.239D-01	1.00	20.5
0.9000D-02	1.00	-0.637	0.999	-0.380D-01	0.999	-0.269D-01	1.00	20.5
0.1000D-01	1.00	-0.708	0.999	-0.422D-01	0.999	-0.299D-01	1.00	20.5
0.2000D-01	1.00	-1.42	0.996	-0.843D-01	0.997	-0.597D-01	0.999	20.4
0.3000D-01	1.00	-2.13	0.990	-0.126	0.993	-0.892D-01	0.997	20.4
0.4000D-01	1.00	-2.84	0.982	-0.167	0.988	-0.118	0.995	20.4
0.5000D-01	1.00	-3.56	0.972	-0.208	0.981	-0.147	0.992	20.3
0.6000D-01	1.00	-4.29	0.960	-0.248	0.973	-0.175	0.989	20.2
0.7000D-01	1.00	-5.02	0.946	-0.287	0.964	-0.203	0.985	20.1
0.8000D-01	1.01	-5.76	0.930	-0.326	0.953	-0.229	0.980	20.1
0.9000D-01	1.01	-6.51	0.912	-0.363	0.941	-0.255	0.975	19.9
0.100	1.01	-7.26	0.892	-0.398	0.928	-0.280	0.970	19.8
0.200	1.02	-15.4	0.622	-0.673	0.761	-0.472	0.895	18.3
0.300	1.03	-24.3	0.301	-0.777	0.577	-0.568	0.810	16.6
0.400	1.02	-33.1	0.156D-01	-0.746	0.413	-0.605	0.732	15.0
0.500	1.01	-41.6	-0.199	-0.634	0.270	-0.602	0.660	13.5
0.600	0.998	-50.3	-0.340	-0.482	0.154	-0.571	0.591	12.1
0.700	0.977	-59.3	-0.411	-0.319	0.656D-01	-0.529	0.533	10.9
0.800	0.944	-67.7	-0.424	-0.169	-0.432D-02	-0.484	0.484	9.89
0.900	0.913	-75.6	-0.397	-0.464D-01	-0.591D-01	-0.434	0.438	8.96
1.00	0.886	-83.4	-0.349	0.474D-01	-0.985D-01	-0.385	0.397	8.13

TABLE XIX

RUN ID H-17

CONTD.

DEAD TIME= 0.800 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.630	-153.	0.650D-01	0.773D-01	-0.148	-0.625D-01	0.160	3.28
3.00	0.487	143.	0.232D-01	-0.240D-01	-0.679D-01	0.107D-01	0.687D-01	1.41
4.00	0.396	77.8	-0.919D-02	-0.836D-02	-0.256D-01	0.182D-01	0.314D-01	0.642
5.00	0.239	-6.61	-0.236D-02	0.264D-02	-0.111D-01	0.985D-02	0.148D-01	0.303
6.00	0.341	-73.3	0.151D-02	0.243D-02	-0.556D-02	0.628D-02	0.839D-02	0.172
7.00	0.470	158.	0.966D-03	-0.230D-02	-0.377D-02	0.374D-02	0.531D-02	0.109
8.00	0.515	55.9	-0.147D-02	0.381D-03	-0.982D-03	0.277D-02	0.294D-02	0.602D-01
9.00	0.264	-33.6	-0.125D-03	0.521D-03	-0.149D-02	0.139D-02	0.203D-02	0.416D-01
10.0	0.260	-76.4	0.414D-03	0.317D-03	-0.810D-03	0.183D-02	0.200D-02	0.410D-01

TABLE XX

RUN ID H-19

COMMENTS HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 3 LINE APP 1/22/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.03	0.0000D 00	12.7	0.0000D 00	12.3	0.0000D 00	1.00	12.3
0.1000D-02	1.00	0.2090D-02	1.00	-0.2890D-02	1.00	-0.2930D-02	1.00	12.3
0.2000D-02	1.00	0.4190D-02	1.00	-0.5780D-02	1.00	-0.5850D-02	1.00	12.3
0.3000D-02	1.00	0.6280D-02	1.00	-0.8670D-02	1.00	-0.8780D-02	1.00	12.3
0.4000D-02	1.00	0.8370D-02	1.00	-0.1160D-01	1.00	-0.1170D-01	1.00	12.3
0.5000D-02	1.00	0.1050D-01	1.00	-0.1450D-01	1.00	-0.1460D-01	1.00	12.3
0.6000D-02	1.00	0.1250D-01	1.00	-0.1730D-01	1.00	-0.1760D-01	1.00	12.3
0.7000D-02	1.00	0.1460D-01	1.00	-0.2020D-01	1.00	-0.2050D-01	1.00	12.3
0.8000D-02	1.00	0.1670D-01	1.00	-0.2310D-01	1.00	-0.2340D-01	1.00	12.3
0.9000D-02	1.00	0.1880D-01	1.00	-0.2600D-01	0.999	-0.2630D-01	1.00	12.3
0.1000D-01	1.00	0.2080D-01	0.999	-0.2890D-01	0.999	-0.2930D-01	1.00	12.3
0.2000D-01	1.00	0.4080D-01	0.998	-0.5770D-01	0.997	-0.5840D-01	0.999	12.3
0.3000D-01	1.00	0.5920D-01	0.995	-0.8640D-01	0.994	-0.8740D-01	0.998	12.3
0.4000D-01	1.00	0.7520D-01	0.990	-0.115	0.989	-0.116	0.996	12.3
0.5000D-01	1.00	0.8810D-01	0.985	-0.143	0.983	-0.144	0.993	12.2
0.6000D-01	1.00	0.9700D-01	0.979	-0.171	0.975	-0.172	0.990	12.2
0.7000D-01	1.00	0.101	0.971	-0.199	0.967	-0.200	0.987	12.2
0.8000D-01	1.01	0.100	0.962	-0.226	0.957	-0.226	0.983	12.1
0.9000D-01	1.01	0.9270D-01	0.953	-0.252	0.946	-0.252	0.979	12.1
0.100	1.01	0.7870D-01	0.942	-0.278	0.934	-0.277	0.974	12.0
0.200	1.03	-0.548	0.787	-0.499	0.769	-0.478	0.906	11.2
0.300	1.05	-2.18	0.583	-0.631	0.578	-0.579	0.818	10.1
0.400	1.06	-4.43	0.379	-0.677	0.407	-0.610	0.733	9.03
0.500	1.05	-6.58	0.206	-0.661	0.267	-0.602	0.658	8.11
0.600	1.04	-8.37	0.7180D-01	-0.614	0.154	-0.572	0.593	7.30
0.700	1.03	-10.1	-0.3010D-01	-0.552	0.6550D-01	-0.531	0.535	6.59
0.800	1.02	-12.0	-0.106	-0.483	-0.3020D-02	-0.487	0.487	6.00
0.900	0.991	-13.6	-0.160	-0.412	-0.5890D-01	-0.442	0.446	5.49
1.00	0.965	-14.6	-0.193	-0.342	-0.104	-0.394	0.407	5.02

TABLE XX

RUN ID H-19

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.812	-20.5	-0.137	-0.553D-03	-0.157	-0.594D-01	0.168	2.07
3.00	0.614	-20.3	-0.386D-01	0.302D-01	-0.760D-01	0.243D-01	0.798D-01	0.983
4.00	0.504	-16.2	-0.685D-02	0.184D-01	-0.233D-01	0.312D-01	0.389D-01	0.480
5.00	0.337	21.6	-0.251D-02	0.557D-02	-0.854D-03	0.181D-01	0.181D-01	0.224
6.00	0.389	60.1	-0.157D-02	0.459D-02	0.822D-02	0.937D-02	0.125D-01	0.154
7.00	0.222	165.	-0.191D-02	0.808D-03	0.925D-02	-0.122D-02	0.933D-02	0.115
8.00	0.183	174.	-0.119D-02	0.154D-02	0.741D-02	-0.766D-02	0.107D-01	0.131
9.00	0.151	-137.	-0.107D-02	0.116D-02	-0.812D-04	-0.104D-01	0.104D-01	0.128
10.0	0.108	-137.	-0.339D-03	0.104D-02	-0.422D-02	-0.914D-02	0.101D-01	0.124

TABLE XX CONTD.

RUN ID H-19

COMMENTS HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 3 LINE APP 1/22/69

DEAD TIME= 0.850 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.03	0.0000D 00	12.7	0.000D 00	12.3	0.000D 00	1.00	12.3
0.1000D-02	1.00	-0.466D-01	1.00	-0.374D-02	1.00	-0.293D-02	1.00	12.3
0.2000D-02	1.00	-0.932D-01	1.00	-0.748D-02	1.00	-0.585D-02	1.00	12.3
0.3000D-02	1.00	-0.140	1.00	-0.112D-01	1.00	-0.878D-02	1.00	12.3
0.4000D-02	1.00	-0.186	1.00	-0.150D-01	1.00	-0.117D-01	1.00	12.3
0.5000D-02	1.00	-0.233	1.00	-0.187D-01	1.00	-0.146D-01	1.00	12.3
0.6000D-02	1.00	-0.280	1.00	-0.224D-01	1.00	-0.176D-01	1.00	12.3
0.7000D-02	1.00	-0.326	1.00	-0.262D-01	1.00	-0.205D-01	1.00	12.3
0.8000D-02	1.00	-0.373	0.999	-0.299D-01	1.00	-0.234D-01	1.00	12.3
0.9000D-02	1.00	-0.420	0.999	-0.337D-01	0.999	-0.263D-01	1.00	12.3
0.1000D-01	1.00	-0.466	0.999	-0.374D-01	0.999	-0.293D-01	1.00	12.3
0.2000D-01	1.00	-0.933	0.996	-0.747D-01	0.997	-0.584D-01	0.999	12.3
0.3000D-01	1.00	-1.40	0.992	-0.112	0.994	-0.874D-01	0.998	12.3
0.4000D-01	1.00	-1.87	0.986	-0.149	0.989	-0.116	0.996	12.3
0.5000D-01	1.00	-2.35	0.978	-0.185	0.983	-0.144	0.993	12.2
0.6000D-01	1.00	-2.83	0.969	-0.221	0.975	-0.172	0.990	12.2
0.7000D-01	1.00	-3.31	0.958	-0.256	0.967	-0.200	0.987	12.2
0.8000D-01	1.01	-3.80	0.945	-0.291	0.957	-0.226	0.983	12.1
0.9000D-01	1.01	-4.29	0.931	-0.324	0.946	-0.252	0.979	12.1
0.100	1.01	-4.79	0.915	-0.357	0.934	-0.277	0.974	12.0
0.200	1.03	-10.3	0.691	-0.625	0.769	-0.478	0.906	11.2
0.300	1.05	-16.8	0.405	-0.758	0.578	-0.579	0.818	10.1
0.400	1.06	-23.9	0.132	-0.764	0.407	-0.610	0.733	9.03
0.500	1.05	-30.9	-0.848D-01	-0.688	0.267	-0.602	0.658	8.11
0.600	1.04	-37.6	-0.237	-0.571	0.154	-0.572	0.593	7.30
0.700	1.03	-44.2	-0.334	-0.440	0.655D-01	-0.531	0.535	6.59
0.800	1.02	-51.0	-0.387	-0.309	-0.302D-02	-0.487	0.487	6.00
0.900	0.991	-57.5	-0.401	-0.186	-0.589D-01	-0.442	0.446	5.49
1.00	0.965	-63.3	-0.384	-0.812D-01	-0.104	-0.394	0.407	5.02

TABLE XX

RUN ID H-19

CONTD.

DEAD TIME= 0.850 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.812	-118.	0.170D-01	0.135	-0.157	-0.594D-01	0.168	2.07
3.00	0.614	-166.	0.489D-01	-0.352D-02	-0.760D-01	0.243D-01	0.798D-01	0.983
4.00	0.504	149.	0.192D-02	-0.195D-01	-0.233D-01	0.312D-01	0.389D-01	0.480
5.00	0.337	138.	-0.386D-02	-0.473D-02	-0.854D-03	0.181D-01	0.181D-01	0.224
6.00	0.389	128.	-0.484D-02	0.284D-03	0.822D-02	0.937D-02	0.125D-01	0.154
7.00	0.222	-176.	-0.207D-02	0.138D-03	0.925D-02	-0.122D-02	0.933D-02	0.115
8.00	0.183	144.	-0.275D-03	0.193D-02	0.741D-02	-0.766D-02	0.107D-01	0.131
9.00	0.151	145.	0.918D-03	0.128D-02	-0.812D-04	-0.104D-01	0.104D-01	0.128
10.0	0.108	95.9	0.103D-02	-0.353D-03	-0.422D-02	-0.914D-02	0.101D-01	0.124

TABLE XXI

RUN ID H-21

COMMENTS HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.14	0.0000D 00	19.3	0.0000D 00	16.9	0.0000D 00	1.00	16.9
0.1000D-02	1.00	-0.1230D-01	1.00	-0.3190D-02	1.00	-0.2980D-02	1.00	16.9
0.2000D-02	1.00	-0.2450D-01	1.00	-0.6390D-02	1.00	-0.5960D-02	1.00	16.9
0.3000D-02	1.00	-0.3680D-01	1.00	-0.9580D-02	1.00	-0.8940D-02	1.00	16.9
0.4000D-02	1.00	-0.4900D-01	1.00	-0.1280D-01	1.00	-0.1190D-01	1.00	16.9
0.5000D-02	1.00	-0.6130D-01	1.00	-0.1600D-01	1.00	-0.1490D-01	1.00	16.9
0.6000D-02	1.00	-0.7350D-01	1.00	-0.1920D-01	1.00	-0.1790D-01	1.00	16.9
0.7000D-02	1.00	-0.8580D-01	1.00	-0.2240D-01	1.00	-0.2090D-01	1.00	16.9
0.8000D-02	1.00	-0.9810D-01	1.00	-0.2560D-01	1.00	-0.2380D-01	1.00	16.9
0.9000D-02	1.00	-0.110	0.999	-0.2870D-01	0.999	-0.2680D-01	1.00	16.9
0.1000D-01	1.00	-0.123	0.999	-0.3190D-01	0.999	-0.2980D-01	1.00	16.9
0.2000D-01	1.00	-0.246	0.997	-0.6380D-01	0.997	-0.5950D-01	0.999	16.9
0.3000D-01	1.00	-0.370	0.993	-0.9540D-01	0.993	-0.8900D-01	0.997	16.8
0.4000D-01	1.00	-0.496	0.988	-0.127	0.988	-0.118	0.995	16.8
0.5000D-01	1.00	-0.624	0.982	-0.158	0.982	-0.147	0.993	16.8
0.6000D-01	1.00	-0.755	0.974	-0.188	0.974	-0.175	0.989	16.7
0.7000D-01	1.00	-0.889	0.964	-0.218	0.965	-0.203	0.986	16.6
0.8000D-01	1.00	-1.03	0.953	-0.248	0.954	-0.230	0.981	16.6
0.9000D-01	1.00	-1.17	0.942	-0.276	0.942	-0.256	0.976	16.5
0.100	1.01	-1.32	0.928	-0.304	0.930	-0.281	0.971	16.4
0.200	1.02	-3.15	0.747	-0.529	0.759	-0.477	0.896	15.1
0.300	1.04	-5.84	0.525	-0.646	0.567	-0.568	0.803	13.5
0.400	1.04	-9.19	0.318	-0.674	0.406	-0.592	0.718	12.1
0.500	1.02	-12.5	0.146	-0.650	0.276	-0.589	0.650	11.0
0.600	1.00	-15.2	0.878D-02	-0.593	0.163	-0.567	0.590	9.96
0.700	0.985	-17.7	-0.928D-01	-0.516	0.696D-01	-0.527	0.532	8.98
0.800	0.963	-20.4	-0.160	-0.432	0.926D-03	-0.478	0.478	8.07
0.900	0.931	-22.9	-0.199	-0.352	-0.490D-01	-0.431	0.434	7.33
1.00	0.897	-24.8	-0.219	-0.282	-0.901D-01	-0.388	0.398	6.72

TABLE XXI

RUN ID H-21

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

UMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.659	-33.3	-0.104	0.158D-01	-0.146	-0.671D-01	0.160	2.70
3.00	0.535	-34.7	-0.276D-01	0.242D-01	-0.681D-01	0.784D-02	0.686D-01	1.16
4.00	0.472	-37.9	-0.585D-02	0.141D-01	-0.281D-01	0.160D-01	0.324D-01	0.546
5.00	0.302	-25.7	-0.253D-02	0.484D-02	-0.145D-01	0.108D-01	0.181D-01	0.305
6.00	0.346	-21.7	-0.165D-02	0.344D-02	-0.807D-02	0.742D-02	0.110D-01	0.185
7.00	0.169	-1.22	-0.810D-03	0.819D-03	-0.489D-02	0.473D-02	0.680D-02	0.115
8.00	0.283	-13.7	-0.315D-03	0.132D-02	-0.219D-02	0.428D-02	0.481D-02	0.811D-01
9.00	0.577	15.9	-0.158D-02	0.178D-02	-0.179D-02	0.372D-02	0.413D-02	0.696D-01
10.0	0.298	5.59	-0.281D-03	0.889D-03	-0.648D-03	0.306D-02	0.313D-02	0.528D-01

TABLE XXI CONTD.

RUN ID H-21

COMMENTS HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.14	0.000D 00	19.3	0.000D 00	16.9	0.000D 00	1.00	16.9
0.100D-02	1.00	-0.380D-01	1.00	-0.364D-02	1.00	-0.298D-02	1.00	16.9
0.200D-02	1.00	-0.761D-01	1.00	-0.729D-02	1.00	-0.596D-02	1.00	16.9
0.300D-02	1.00	-0.114	1.00	-0.109D-01	1.00	-0.894D-02	1.00	16.9
0.400D-02	1.00	-0.152	1.00	-0.146D-01	1.00	-0.119D-01	1.00	16.9
0.500D-02	1.00	-0.190	1.00	-0.182D-01	1.00	-0.149D-01	1.00	16.9
0.600D-02	1.00	-0.228	1.00	-0.219D-01	1.00	-0.179D-01	1.00	16.9
0.700D-02	1.00	-0.266	1.00	-0.255D-01	1.00	-0.209D-01	1.00	16.9
0.800D-02	1.00	-0.304	0.999	-0.291D-01	1.00	-0.238D-01	1.00	16.9
0.900D-02	1.00	-0.342	0.999	-0.328D-01	0.999	-0.268D-01	1.00	16.9
0.100D-01	1.00	-0.380	0.999	-0.364D-01	0.999	-0.298D-01	1.00	16.9
0.200D-01	1.00	-0.761	0.996	-0.727D-01	0.997	-0.595D-01	0.999	16.9
0.300D-01	1.00	-1.14	0.992	-0.109	0.993	-0.890D-01	0.997	16.8
0.400D-01	1.00	-1.53	0.986	-0.145	0.988	-0.118	0.995	16.8
0.500D-01	1.00	-1.91	0.978	-0.180	0.982	-0.147	0.993	16.8
0.600D-01	1.00	-2.30	0.968	-0.215	0.974	-0.175	0.989	16.7
0.700D-01	1.00	-2.69	0.957	-0.249	0.965	-0.203	0.986	16.6
0.800D-01	1.00	-3.09	0.944	-0.282	0.954	-0.230	0.981	16.6
0.900D-01	1.00	-3.49	0.930	-0.314	0.942	-0.256	0.976	16.5
0.100	1.01	-3.89	0.914	-0.346	0.930	-0.281	0.971	16.4
0.200	1.02	-8.31	0.696	-0.594	0.759	-0.477	0.896	15.1
0.300	1.04	-13.6	0.433	-0.710	0.567	-0.568	0.803	13.5
0.400	1.04	-19.5	0.192	-0.720	0.406	-0.592	0.718	12.1
0.500	1.02	-25.3	-0.290D-02	-0.666	0.276	-0.589	0.650	11.0
0.600	1.00	-30.7	-0.150	-0.574	0.163	-0.567	0.590	9.96
0.700	0.985	-35.8	-0.248	-0.461	0.696D-01	-0.527	0.532	8.98
0.800	0.963	-41.0	-0.301	-0.348	0.926D-03	-0.478	0.478	8.07
0.900	0.931	-46.1	-0.321	-0.246	-0.490D-01	-0.431	0.434	7.33
1.00	0.897	-50.5	-0.320	-0.159	-0.901D-01	-0.388	0.398	6.72

TABLE XXI

RUN ID H-21

CONTD.

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.659	-84.9	-0.526D-01	0.917D-01	-0.146	-0.671D-01	0.160	2.70
3.00	0.535	-112.	0.176D-01	0.323D-01	-0.681D-01	0.784D-02	0.686D-01	1.16
4.00	0.472	-141.	0.151D-01	0.249D-02	-0.281D-01	0.160D-01	0.324D-01	0.546
5.00	0.302	-155.	0.536D-02	-0.107D-02	-0.145D-01	0.108D-01	0.181D-01	0.305
6.00	0.348	-176.	0.296D-02	-0.240D-02	-0.807D-02	0.742D-02	0.110D-01	0.185
7.00	0.169	178.	0.803D-03	-0.825D-03	-0.489D-02	0.473D-02	0.680D-02	0.115
8.00	0.283	140.	-0.303D-03	-0.133D-02	-0.219D-02	0.428D-02	0.481D-02	0.811D-01
9.00	0.577	144.	-0.431D-03	-0.234D-02	-0.179D-02	0.372D-02	0.413D-02	0.696D-01
10.0	0.298	108.	-0.810D-03	-0.462D-03	-0.648D-03	0.306D-02	0.313D-02	0.528D-01

TABLE XXII

RUN ID F-01

COMMENTS FREON-12 TRACER RED IN AIR RATE 6.3 CM 12/27/68

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.890	0.0000D 00	311.	0.0000D 00	350.	0.0000 00	1.00	350.
0.1000D-01	0.987	-9.25	0.942	-0.275	0.987	-0.122	0.995	348.
0.2000D-01	0.948	-18.3	0.784	-0.495	0.950	-0.236	0.978	342.
0.3000D-01	0.886	-26.9	0.568	-0.623	0.891	-0.337	0.952	333.
0.4000D-01	0.805	-34.8	0.347	-0.652	0.816	-0.420	0.918	321.
0.5000D-01	0.710	-41.4	0.163	-0.601	0.731	-0.483	0.876	306.
0.6000D-01	0.611	-46.3	0.404D-01	-0.505	0.643	-0.524	0.829	290.
0.7000D-01	0.517	-48.5	-0.205D-01	-0.402	0.557	-0.545	0.779	272.
0.8000D-01	0.438	-47.6	-0.369D-01	-0.317	0.477	-0.550	0.728	255.
0.9000D-01	0.384	-43.8	-0.309D-01	-0.259	0.408	-0.542	0.678	237.
0.100	0.356	-38.8	-0.202D-01	-0.224	0.349	-0.526	0.631	221.
0.200	0.367	-26.9	-0.293D-01	-0.137	0.969D-01	-0.368	0.381	133.
0.300	0.331	-26.5	-0.314D-01	-0.859D-01	0.311D-01	-0.275	0.277	96.7
0.400	0.347	-34.8	-0.468D-01	-0.601D-01	-0.118D-01	-0.219	0.220	76.8
0.500	0.320	-41.4	-0.488D-01	-0.361D-01	-0.397D-01	-0.186	0.190	66.4
0.600	0.290	-46.3	-0.437D-01	-0.175D-01	-0.604D-01	-0.151	0.162	56.8
0.700	0.296	-54.7	-0.416D-01	-0.373D-02	-0.709D-01	-0.122	0.141	49.3
0.800	0.247	-60.8	-0.299D-01	0.596D-02	-0.803D-01	-0.939D-01	0.124	43.2
0.900	0.240	-71.4	-0.225D-01	0.129D-01	-0.807D-01	-0.718D-01	0.108	37.8
1.00	0.195	-75.6	-0.141D-01	0.131D-01	-0.832D-01	-0.534D-01	0.989D-01	34.6
2.00	0.235D-01	-53.5	0.363D-04	0.577D-03	-0.188D-01	0.158D-01	0.246D-01	8.60
3.00	0.676D-01	110.	-0.390D-03	-0.147D-03	-0.206D-04	0.617D-02	0.617D-02	2.16
4.00	0.177	62.5	-0.307D-03	0.696D-04	-0.454D-03	0.172D-02	0.178D-02	0.624
5.00	0.168	-45.7	0.165D-04	0.177D-03	-0.684D-03	0.805D-03	0.106D-02	0.369
6.00	0.810D-01	-133.	0.582D-04	-0.451D-04	-0.853D-04	0.905D-03	0.909D-03	0.318
7.00	0.840	-91.4	-0.130D-03	0.101D-03	-0.116D-03	-0.158D-03	0.196D-03	0.685D-01
8.00	0.955	132.	0.219D-03	-0.167D-04	-0.167D-03	-0.158D-03	0.229D-03	0.802D-01
9.00	0.249	103.	-0.106D-03	-0.620D-04	-0.146D-03	0.472D-03	0.494D-03	0.173
10.0	0.378	77.3	-0.109D-03	-0.354D-04	-0.155D-03	0.261D-03	0.304D-03	0.106

TABLE XXII

RUN ID F-01

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
11.0	0.208	0.383	0.188D-04	0.517D-04	0.920D-04	0.247D-03	0.264D-03	0.923D-01
21.0	0.275	-41.6	-0.141D-04	-0.814D-05	-0.188D-04	-0.563D-04	0.593D-04	0.207D-01
31.0	0.388D-01	-125.	0.116D-05	-0.408D-06	-0.849D-05	0.305D-04	0.316D-04	0.111D-01
41.0	0.163	-86.3	-0.165D-05	0.753D-06	-0.527D-05	-0.982D-05	0.111D-04	0.390D-02
51.0	0.277	-59.0	-0.784D-05	0.342D-06	-0.156D-04	-0.236D-04	0.283D-04	0.990D-02
61.0	0.338	27.3	-0.741D-06	0.256D-05	0.844D-06	0.786D-05	0.790D-05	0.276D-02
71.0	0.352	-22.7	-0.731D-06	-0.776D-06	-0.106D-05	-0.284D-05	0.303D-05	0.106D-02
81.0	0.613D-01	148.	-0.513D-07	-0.241D-06	-0.137D-05	0.378D-05	0.402D-05	0.141D-02
91.0	0.416	-122.	-0.361D-06	0.890D-06	-0.136D-05	-0.186D-05	0.231D-05	0.807D-03
101.	0.326	-39.4	-0.104D-05	-0.930D-06	-0.663D-06	-0.423D-05	0.428D-05	0.150D-02

TABLE XXII CONTD.

RUN ID F-01

COMMENTS FREON-12 TRACER RED IN AIR RATE 6.3 CM 12/27/68

DEAD TIME= 1.85 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.890	0.0000D 00	311.	0.0000D 00	350.	0.0000D 00	1.00	350.
0.1000D-01	0.987	-10.3	0.937	-0.292	0.987	-0.122	0.995	348.
0.2000D-01	0.948	-20.4	0.765	-0.524	0.950	-0.236	0.978	342.
0.3000D-01	0.886	-30.1	0.533	-0.654	0.891	-0.337	0.952	333.
0.4000D-01	0.805	-39.0	0.297	-0.676	0.816	-0.420	0.918	321.
0.5000D-01	0.710	-46.7	0.107	-0.613	0.731	-0.483	0.876	306.
0.6000D-01	0.611	-52.6	-0.157D-01	-0.506	0.643	-0.524	0.829	290.
0.7000D-01	0.517	-55.9	-0.723D-01	-0.396	0.557	-0.545	0.779	272.
0.8000D-01	0.438	-56.1	-0.832D-01	-0.308	0.477	-0.550	0.728	255.
0.9000D-01	0.384	-53.3	-0.734D-01	-0.250	0.408	-0.542	0.678	237.
0.100	0.356	-49.4	-0.610D-01	-0.216	0.349	-0.526	0.631	221.
0.200	0.367	-48.1	-0.767D-01	-0.117	0.969D-01	-0.368	0.381	133.
0.300	0.331	-58.3	-0.720D-01	-0.565D-01	0.311D-01	-0.275	0.277	96.7
0.400	0.347	-77.2	-0.751D-01	-0.129D-01	-0.118D-01	-0.219	0.220	76.8
0.500	0.320	-94.4	-0.582D-01	0.172D-01	-0.397D-01	-0.186	0.190	66.4
0.600	0.290	-110.	-0.351D-01	0.314D-01	-0.604D-01	-0.151	0.162	56.8
0.700	0.296	-129.	-0.149D-01	0.390D-01	-0.709D-01	-0.122	0.141	49.3
0.800	0.247	-146.	0.322D-02	0.303D-01	-0.803D-01	-0.939D-01	0.124	43.2
0.900	0.240	-167.	0.149D-01	0.212D-01	-0.807D-01	-0.718D-01	0.108	37.8
1.00	0.195	178.	0.165D-01	0.996D-02	-0.832D-01	-0.534D-01	0.989D-01	34.6
2.00	0.235D-01	94.5	-0.336D-03	-0.470D-03	-0.188D-01	0.158D-01	0.246D-01	8.60
3.00	0.676D-01	152.	-0.101D-03	-0.370D-03	-0.206D-04	0.617D-02	0.617D-02	2.16
4.00	0.177	-1.49	-0.722D-04	0.307D-03	-0.454D-03	0.172D-02	0.178D-02	0.624
5.00	0.168	144.	0.145D-04	-0.177D-03	-0.684D-03	0.805D-03	0.106D-02	0.369
6.00	0.810D-01	-49.1	0.509D-04	0.532D-04	-0.853D-04	0.905D-03	0.909D-03	0.318
7.00	0.840	-113.	-0.828D-04	0.142D-03	-0.116D-03	-0.158D-03	0.196D-03	0.685D-01
8.00	0.955	4.28	-0.148D-03	-0.162D-03	-0.167D-03	-0.158D-03	0.229D-03	0.802D-01
9.00	0.249	-131.	0.113D-03	-0.494D-04	-0.146D-03	0.472D-03	0.494D-03	0.173
10.0	0.378	97.3	-0.904D-04	-0.706D-04	-0.155D-03	0.261D-03	0.304D-03	0.106

TABLE XXII

RUN ID F-01

CONTD.

DEAD TIME= 1.85 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
11.0	0.208	-85.6	0.529D-04	-0.151D-04	0.920D-04	0.247D-03	0.264D-03	0.923D-01
21.0	0.275	-108.	-0.132D-04	0.957D-05	-0.188D-04	-0.563D-04	0.593D-04	0.207D-01
31.0	0.388D-01	-171.	0.513D-06	-0.112D-05	-0.849D-05	0.305D-04	0.316D-04	0.111D-01
41.0	0.163	-112.	-0.115D-05	0.140D-05	-0.527D-05	-0.982D-05	0.111D-04	0.390D-02
51.0	0.277	-64.8	-0.777D-05	0.114D-05	-0.156D-04	-0.236D-04	0.283D-04	0.990D-02
61.0	0.338	36.4	-0.135D-05	0.230D-05	0.844D-06	0.786D-05	0.790D-05	0.276D-02
71.0	0.352	11.5	-0.168D-06	-0.105D-05	-0.106D-05	-0.284D-05	0.303D-05	0.106D-02
81.0	0.613D-01	-158.	0.145D-06	-0.182D-06	-0.137D-05	0.378D-05	0.402D-05	0.141D-02
91.0	0.416	-47.5	-0.954D-06	-0.106D-06	-0.136D-05	-0.186D-05	0.231D-05	0.807D-03
101.	0.326	54.9	0.101D-05	-0.971D-06	-0.663D-06	-0.423D-05	0.428D-05	0.150D-02

TABLE XXIII

RUN ID F-02

COMMENTS F- 12 BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 5 LINE APP 1/9/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.07	0.0000 00	179.	0.0000 00	168.	0.0000 00	1.00	168.
0.1000-02	1.00	-0.625	1.00	-0.234D-01	1.00	-0.125D-01	1.00	168.
0.2000-02	1.00	-1.25	0.998	-0.468D-01	0.999	-0.2500-01	1.00	168.
0.3000-02	0.999	-1.87	0.996	-0.701D-01	0.999	-0.375D-01	1.00	168.
0.4000-02	0.999	-2.50	0.994	-0.933D-01	0.998	-0.5000-01	0.999	168.
0.5000-02	0.998	-3.12	0.990	-0.116	0.997	-0.625D-01	0.999	168.
0.600D-02	0.997	-3.74	0.985	-0.139	0.995	-0.749D-01	0.998	168.
0.7000-02	0.996	-4.37	0.980	-0.162	0.993	-0.873D-01	0.997	168.
0.8000-02	0.995	-4.99	0.974	-0.184	0.991	-0.9960-01	0.996	168.
0.900D-02	0.994	-5.61	0.968	-0.207	0.989	-0.112	0.996	168.
0.1000-01	0.992	-6.23	0.960	-0.229	0.987	-0.124	0.994	167.
0.200D-01	0.970	-12.3	0.848	-0.424	0.948	-0.241	0.978	165.
0.300D-01	0.933	-18.2	0.687	-0.563	0.888	-0.343	0.952	160.
0.400D-01	0.885	-23.8	0.504	-0.635	0.811	-0.427	0.917	154.
0.5000-01	0.826	-28.8	0.330	-0.643	0.725	-0.490	0.875	147.
0.6000-01	0.761	-33.2	0.183	-0.603	0.636	-0.531	0.828	139.
0.7000-01	0.693	-36.8	0.748D-01	-0.535	0.549	-0.552	0.778	131.
0.8000-01	0.626	-39.5	0.428D-02	-0.456	0.469	-0.557	0.728	123.
0.900D-01	0.561	-41.2	-0.351D-01	-0.379	0.398	-0.550	0.679	114.
0.100	0.501	-41.8	-0.522D-01	-0.313	0.339	-0.535	0.633	107.
0.200	0.385	2.85	0.388D-01	-0.137	0.8300-01	-0.361	0.370	62.3
0.300	0.485	-10.8	-0.184D-01	-0.131	0.134D-01	-0.272	0.273	45.9
0.400	0.441	-14.2	-0.348D-01	-0.933D-01	-0.245D-01	-0.224	0.226	38.0
0.500	0.449	-16.5	-0.489D-01	-0.716D-01	-0.592D-01	-0.184	0.193	32.5
0.600	0.443	-17.3	-0.546D-01	-0.4960-01	-0.843D-01	-0.144	0.167	28.0
0.700	0.400	-25.0	-0.511D-01	-0.227D-01	-0.918D-01	-0.106	0.140	23.5
0.800	0.391	-20.9	-0.451D-01	-0.135D-01	-0.953D-01	-0.734D-01	0.120	20.2
0.900	0.385	-29.0	-0.394D-01	-0.149D-02	-0.876D-01	-0.530D-01	0.102	17.2
1.00	0.333	-25.5	-0.307D-01	0.313D-02	-0.872D-01	-0.312D-01	0.926D-01	15.6

TABLE XXIII

RUN ID F-02

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.354	-29.3	-0.493D-03	0.682D-02	-0.106D-01	0.161D-01	0.193D-01	3.25
3.00	0.273	-53.7	0.106D-02	0.164D-03	0.181D-02	0.348D-02	0.392D-02	0.660
4.00	0.179	175.	-0.727D-04	-0.114D-03	0.353D-03	0.665D-03	0.753D-03	0.127
5.00	1.31	14.3	-0.435D-03	0.138D-03	-0.296D-03	0.184D-03	0.349D-03	0.587D-01
6.00	0.142	-12.0	0.479D-04	0.149D-04	0.308D-03	0.173D-03	0.353D-03	0.595D-01
7.00	0.113	31.5	-0.298D-04	-0.551D-04	-0.482D-03	-0.280D-03	0.557D-03	0.938D-01
8.00	0.922	-15.8	-0.158D-03	0.192D-03	-0.222D-03	0.154D-03	0.270D-03	0.454D-01
9.00	0.151	-43.0	0.241D-04	0.701D-04	-0.201D-03	0.450D-03	0.493D-03	0.829D-01
10.0	0.218	11.2	0.509D-04	-0.197D-04	0.212D-03	-0.134D-03	0.251D-03	0.422D-01

TABLE XXIII CONTD.

RUN ID F-02

COMMENTS F= 12 BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 5 LINE APP 1/9/69

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.07	0.0000D 00	179.	0.0000D 00	168.	0.0000D 00	1.00	168.
0.1000D-02	1.00	-0.650	1.00	-0.239D-01	1.00	-0.125D-01	1.00	168.
0.2000D-02	1.00	-1.30	0.998	-0.477D-01	0.999	-0.250D-01	1.00	168.
0.3000D-02	0.999	-1.95	0.996	-0.715D-01	0.999	-0.375D-01	1.00	168.
0.4000D-02	0.999	-2.60	0.993	-0.951D-01	0.998	-0.500D-01	0.999	168.
0.5000D-02	0.998	-3.25	0.990	-0.119	0.997	-0.625D-01	0.999	168.
0.6000D-02	0.997	-3.90	0.985	-0.142	0.995	-0.749D-01	0.998	168.
0.7000D-02	0.996	-4.55	0.980	-0.165	0.993	-0.873D-01	0.997	168.
0.8000D-02	0.995	-5.19	0.974	-0.188	0.991	-0.996D-01	0.996	168.
0.9000D-02	0.994	-5.84	0.967	-0.211	0.989	-0.112	0.996	168.
0.1000D-01	0.992	-6.49	0.959	-0.233	0.987	-0.124	0.994	167.
0.2000D-01	0.970	-12.9	0.844	-0.432	0.946	-0.241	0.978	165.
0.3000D-01	0.933	-19.0	0.679	-0.573	0.888	-0.343	0.952	160.
0.4000D-01	0.885	-24.8	0.493	-0.644	0.811	-0.427	0.917	154.
0.5000D-01	0.826	-30.1	0.315	-0.651	0.725	-0.490	0.875	147.
0.6000D-01	0.761	-34.8	0.167	-0.608	0.636	-0.531	0.828	139.
0.7000D-01	0.693	-36.6	0.579D-01	-0.537	0.549	-0.552	0.778	131.
0.8000D-01	0.626	-41.6	-0.121D-01	-0.455	0.469	-0.557	0.728	123.
0.9000D-01	0.561	-43.5	-0.504D-01	-0.378	0.398	-0.550	0.679	114.
0.100	0.501	-44.4	-0.663D-01	-0.310	0.339	-0.535	0.633	107.
0.200	0.385	-2.30	0.264D-01	-0.140	0.830D-01	-0.361	0.370	62.3
0.300	0.485	-18.6	-0.359D-01	-0.127	0.134D-01	-0.272	0.273	45.9
0.400	0.441	-24.5	-0.509D-01	-0.855D-01	-0.245D-01	-0.224	0.226	38.0
0.500	0.449	-29.3	-0.636D-01	-0.589D-01	-0.592D-01	-0.184	0.193	32.5
0.600	0.443	-32.8	-0.658D-01	-0.332D-01	-0.843D-01	-0.144	0.167	28.0
0.700	0.400	-43.0	-0.556D-01	-0.581D-02	-0.918D-01	-0.106	0.140	23.5
0.800	0.391	-41.5	-0.469D-01	0.322D-02	-0.953D-01	-0.734D-01	0.120	20.2
0.900	0.385	-52.2	-0.368D-01	0.141D-01	-0.876D-01	-0.530D-01	0.102	17.2
1.00	0.333	-51.3	-0.263D-01	0.162D-01	-0.872D-01	-0.312D-01	0.926D-01	15.6

TABLE XXIII

RUN ID F-02

CONTD.

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.354	-80.8	0.504D-02	0.463D-02	-0.106D-01	0.161D-01	0.193D-01	3.25
3.00	0.273	-131.	0.391D-03	-0.995D-03	0.181D-02	0.348D-02	0.392D-02	0.660
4.00	0.179	72.2	-0.944D-04	0.967D-04	0.353D-03	0.665D-03	0.753D-03	0.127
5.00	1.31	-115.	0.380D-03	0.252D-03	-0.296D-03	0.184D-03	0.349D-03	0.587D-01
6.00	0.142	-167.	-0.370D-04	-0.340D-04	0.308D-03	0.173D-03	0.353D-03	0.595D-01
7.00	0.113	-149.	0.303D-04	0.549D-04	-0.482D-03	-0.280D-03	0.557D-03	0.938D-01
8.00	0.922	136.	0.569D-04	-0.242D-03	-0.222D-03	0.154D-03	0.270D-03	0.454D-01
9.00	0.151	84.9	-0.701D-04	-0.241D-04	-0.201D-03	0.450D-03	0.493D-03	0.829D-01
10.0	0.218	113.	0.848D-05	0.539D-04	0.212D-03	-0.134D-03	0.251D-03	0.422D-01

TABLE XXIV

RUN ID F-03

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000 00	0.717	0.0000 00	100.	0.0000 00	140.	0.0000 00	1.00	140.
0.100D-02	0.957	19.6	1.00	-0.218D-01	0.977	-0.372	1.05	146.
0.200D-02	1.00	9.39	0.999	-0.436D-01	0.976	-0.206	0.998	139.
0.300D-02	1.01	5.51	0.997	-0.654D-01	0.976	-0.159	0.988	138.
0.400D-02	1.01	3.31	0.995	-0.871D-01	0.975	-0.142	0.985	137.
0.500D-02	1.02	1.79	0.992	-0.109	0.973	-0.138	0.983	137.
0.600D-02	1.02	0.624	0.988	-0.130	0.972	-0.139	0.981	137.
0.700D-02	1.02	-0.347	0.984	-0.151	0.970	-0.143	0.980	137.
0.800D-02	1.02	-1.19	0.979	-0.173	0.967	-0.150	0.979	137.
0.900D-02	1.02	-1.96	0.974	-0.194	0.965	-0.158	0.978	136.
0.100D-01	1.02	-2.66	0.968	-0.214	0.962	-0.167	0.976	136.
0.200D-01	1.01	-8.39	0.878	-0.406	0.920	-0.271	0.959	134.
0.300D-01	0.997	-13.3	0.743	-0.556	0.853	-0.371	0.930	130.
0.400D-01	0.983	-17.8	0.584	-0.655	0.770	-0.453	0.893	125.
0.500D-01	0.967	-22.1	0.421	-0.705	0.677	-0.512	0.849	118.
0.600D-01	0.951	-26.0	0.269	-0.712	0.583	-0.548	0.800	112.
0.700D-01	0.938	-29.9	0.138	-0.688	0.493	-0.563	0.748	104.
0.800D-01	0.928	-33.6	0.296D-01	-0.646	0.412	-0.562	0.697	97.2
0.900D-01	0.920	-37.5	-0.574D-01	-0.593	0.343	-0.549	0.647	90.3
0.100	0.914	-41.6	-0.127	-0.536	0.286	-0.530	0.602	84.0
0.200	0.671	-81.7	-0.232	-0.580D-01	0.359D-01	-0.355	0.356	49.7
0.300	0.456	-116.	-0.969D-01	0.652D-01	-0.375D-01	-0.253	0.256	35.7
0.400	0.294	-146.	-0.129D-01	0.580D-01	-0.742D-01	-0.188	0.202	28.2
0.500	0.154	-176.	0.130D-01	0.217D-01	-0.952D-01	-0.135	0.165	23.0
0.600	0.836D-01	145.	0.113D-01	0.124D-02	-0.103	-0.900D-01	0.137	19.0
0.700	0.242D-01	136.	0.265D-02	-0.719D-03	-0.993D-01	-0.546D-01	0.113	15.8
0.800	0.182D-01	127.	0.139D-02	-0.105D-02	-0.922D-01	-0.259D-01	0.958D-01	13.4
0.900	0.230D-01	69.3	-0.519D-03	-0.171D-02	-0.778D-01	-0.530D-02	0.780D-01	10.9
1.00	0.125D-01	83.2	-0.224D-03	-0.776D-03	-0.639D-01	0.104D-01	0.647D-01	9.03

TABLE XXIV

RUN ID F-03

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.131D-01	37.0	-0.654D-04	0.806D-04	-0.286D-03	0.794D-02	0.794D-02	1.11
3.00	0.652	132.	-0.298D-03	-0.105D-03	0.185D-03	0.447D-03	0.484D-03	0.675D-01
4.00	1.22	65.7	-0.369D-03	-0.624D-03	-0.588D-03	0.653D-04	0.592D-03	0.826D-01
5.00	0.243	-68.9	0.131D-03	0.120D-03	-0.266D-03	0.680D-03	0.730D-03	0.102
6.00	0.418	93.3	-0.817D-04	0.450D-04	0.119D-03	0.189D-03	0.223D-03	0.311D-01
7.00	0.689	-83.3	-0.429D-04	0.149D-03	-0.223D-03	-0.365D-04	0.226D-03	0.315D-01
8.00	0.643	-50.8	-0.492D-04	0.787D-04	-0.143D-03	0.179D-04	0.144D-03	0.202D-01
9.00	0.311	50.1	-0.471D-04	0.560D-04	0.409D-04	0.232D-03	0.235D-03	0.328D-01
10.0	0.340	125.	0.416D-04	0.635D-04	0.831D-04	-0.207D-03	0.223D-03	0.312D-01

TABLE XXIV CONTD.

RUN ID F-03

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 26.4 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.717	0.0000D 00	100.	0.0000D 00	140.	0.0000D 00	1.00	140.
0.1000D-02	0.957	18.1	0.999	-0.4820D-01	0.977	-0.372	1.05	146.
0.2000D-02	1.00	6.36	0.995	-0.9630D-01	0.976	-0.206	0.998	139.
0.3000D-02	1.01	0.970	0.989	-0.144	0.976	-0.159	0.988	138.
0.4000D-02	1.01	-2.74	0.980	-0.191	0.975	-0.142	0.985	137.
0.5000D-02	1.02	-5.77	0.969	-0.238	0.973	-0.138	0.983	137.
0.6000D-02	1.02	-8.45	0.955	-0.284	0.972	-0.139	0.981	137.
0.7000D-02	1.02	-10.9	0.940	-0.330	0.970	-0.143	0.980	137.
0.8000D-02	1.02	-13.3	0.921	-0.374	0.967	-0.150	0.979	137.
0.9000D-02	1.02	-15.6	0.901	-0.417	0.965	-0.158	0.978	136.
0.1000D-01	1.02	-17.8	0.879	-0.460	0.962	-0.167	0.976	136.
0.2000D-01	1.01	-38.6	0.554	-0.792	0.920	-0.271	0.959	134.
0.3000D-01	0.997	-58.7	0.127	-0.919	0.853	-0.371	0.930	130.
0.4000D-01	0.983	-78.3	-0.282	-0.831	0.770	-0.453	0.893	125.
0.5000D-01	0.967	-97.7	-0.578	-0.583	0.677	-0.512	0.849	118.
0.6000D-01	0.951	-117.	-0.715	-0.260	0.583	-0.548	0.800	112.
0.7000D-01	0.938	-136.	-0.700	0.5560D-01	0.493	-0.563	0.748	104.
0.8000D-01	0.928	-155.	-0.569	0.307	0.412	-0.562	0.697	97.2
0.9000D-01	0.920	-174.	-0.370	0.467	0.343	-0.549	0.647	90.3
0.100	0.914	167. -193	-0.146	0.530	0.286	-0.530	0.602	84.0
0.200	0.671	-24.3	-0.7590D-01	-0.227	0.3590D-01	-0.355	0.356	49.7
0.300	0.456	151.	0.7140D-01	0.9230D-01	-0.3750D-01	-0.253	0.256	35.7
0.400	0.294	-31.0	-0.4720D-01	-0.3620D-01	-0.7420D-01	-0.188	0.202	28.2
0.500	0.154	148.	0.2340D-01	0.9810D-02	-0.9520D-01	-0.135	0.165	23.0
0.600	0.8360D-01	-42.6	-0.1140D-01	0.2680D-03	-0.103	-0.9000D-01	0.137	19.0
0.700	0.2420D-01	157.	0.2730D-02	0.2850D-03	-0.9930D-01	-0.5460D-01	0.113	15.8
0.800	0.1820D-01	-2.66	-0.1700D-02	-0.3930D-03	-0.9220D-01	-0.2590D-01	0.9580D-01	13.4
0.900	0.2300D-01	148.	0.1580D-02	-0.8460D-03	-0.7780D-01	-0.5300D-02	0.7800D-01	10.9
1.00	0.1250D-01	10.6	-0.8080D-03	-0.1840D-04	-0.6390D-01	0.1040D-01	0.6470D-01	9.03

TABLE XXIV

RUN ID F-03

CONTD.

DEAD TIME= 26.4 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.131D-01	-108.	0.997D-04	-0.289D-04	-0.286D-03	0.794D-02	0.794D-02	1.11
3.00	0.652	-86.0	0.299D-03	-0.100D-03	0.185D-03	0.447D-03	0.484D-03	0.675D-01
4.00	1.22	135.	0.456D-03	-0.564D-03	-0.588D-03	0.653D-04	0.592D-03	0.826D-01
5.00	0.243	-72.0	0.137D-03	0.113D-03	-0.266D-03	0.680D-03	0.730D-03	0.102
6.00	0.418	17.6	0.234D-04	0.903D-04	0.119D-03	0.189D-03	0.223D-03	0.311D-01
7.00	0.689	128.	0.115D-03	-0.105D-03	-0.223D-03	-0.365D-04	0.226D-03	0.315D-01
8.00	0.643	88.3	-0.142D-04	-0.917D-04	-0.143D-03	0.179D-04	0.144D-03	0.202D-01
9.00	0.311	117.	-0.702D-04	-0.209D-04	0.409D-04	0.232D-03	0.235D-03	0.328D-01
10.0	0.340	119.	0.481D-04	0.587D-04	0.831D-04	-0.207D-03	0.223D-03	0.312D-01

TABLE XXV

RUN ID F-04

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.841	0.0000D 00	110.	0.0000D 00	130.	0.0000D 00	1.00	130.
0.1000D-02	1.00	-0.425	1.00	-0.218D-01	1.00	-0.143D-01	1.00	130.
0.2000D-02	1.00	-0.850	0.999	-0.435D-01	0.999	-0.287D-01	1.00	130.
0.3000D-02	1.00	-1.27	0.997	-0.652D-01	0.998	-0.430D-01	0.999	130.
0.4000D-02	1.00	-1.70	0.995	-0.868D-01	0.997	-0.573D-01	0.999	130.
0.5000D-02	1.00	-2.12	0.992	-0.108	0.996	-0.715D-01	0.998	130.
0.6000D-02	0.999	-2.55	0.988	-0.130	0.994	-0.857D-01	0.997	130.
0.7000D-02	0.999	-2.97	0.984	-0.151	0.991	-0.998D-01	0.996	130.
0.8000D-02	0.999	-3.39	0.979	-0.172	0.989	-0.114	0.995	130.
0.9000D-02	0.999	-3.82	0.974	-0.193	0.986	-0.128	0.994	130.
0.1000D-01	0.998	-4.24	0.968	-0.213	0.983	-0.142	0.993	130.
0.2000D-01	0.993	-8.42	0.877	-0.403	0.933	-0.272	0.972	127.
0.3000D-01	0.986	-12.5	0.743	-0.551	0.857	-0.382	0.938	122.
0.4000D-01	0.976	-16.4	0.586	-0.648	0.763	-0.466	0.894	117.
0.5000D-01	0.967	-20.2	0.426	-0.695	0.662	-0.522	0.843	110.
0.6000D-01	0.959	-23.9	0.278	-0.702	0.562	-0.551	0.787	103.
0.7000D-01	0.952	-27.6	0.151	-0.679	0.472	-0.558	0.731	95.4
0.8000D-01	0.948	-31.4	0.468D-01	-0.640	0.394	-0.550	0.677	88.3
0.9000D-01	0.945	-35.5	-0.380D-01	-0.592	0.331	-0.534	0.678	81.9
0.100	0.939	-39.9	-0.107	-0.539	0.281	-0.514	0.586	76.4
0.200	0.728	-77.1	-0.241	-0.747D-01	0.260D-01	-0.346	0.347	45.3
0.300	0.484	-113.	-0.103	0.652D-01	-0.404D-01	-0.249	0.252	37.9
0.400	0.303	-146.	-0.123D-01	0.579D-01	-0.739D-01	-0.181	0.195	25.5
0.500	0.171	-177.	0.144D-01	0.233D-01	-0.904D-01	-0.132	0.160	20.9
0.600	0.603D-01	176.	0.659D-02	0.506D-02	-0.103	-0.919D-01	0.138	18.0
0.700	0.564D-01	160.	0.620D-02	0.796D-03	-0.986D-01	-0.505D-01	0.111	14.5
0.800	0.330D-01	108.	0.168D-02	-0.257D-02	-0.897D-01	-0.248D-01	0.930D-01	12.1
0.900	0.201D-01	-21.6	-0.144D-02	0.500D-03	-0.757D-01	-0.317D-02	0.757D-01	9.88
1.00	0.104D-01	179.	0.643D-03	-0.110D-03	-0.618D-01	0.954D-02	0.626D-01	8.16

TABLE XXV

RUN ID F-04

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.140	33.3	-0.630D-03	0.831D-03	-0.473D-03	0.705D-02	0.707D-02	0.922
3.00	0.904	104.	-0.741D-03	0.602D-03	0.849D-03	0.627D-03	0.106D-02	0.139
4.00	0.292	72.4	0.895D-04	-0.107D-03	-0.256D-03	-0.403D-03	0.477D-03	0.623D-01
5.00	2.38	-11.7	-0.596D-03	0.505D-03	-0.288D-03	0.157D-03	0.328D-03	0.428D-01
6.00	0.249	149.	0.747D-04	-0.279D-04	-0.316D-03	-0.579D-04	0.321D-03	0.419D-01
7.00	0.365	81.4	-0.203D-04	-0.111D-03	-0.310D-03	0.929D-05	0.310D-03	0.404D-01
8.00	0.389	-82.9	-0.404D-04	0.142D-03	-0.374D-03	-0.581D-04	0.379D-03	0.494D-01
9.00	0.150	132.	0.526D-06	-0.382D-04	-0.190D-03	0.169D-03	0.254D-03	0.332D-01
10.0	0.145	32.8	-0.898D-05	0.197D-04	0.216D-04	0.148D-03	0.150D-03	0.196D-01

TABLE XXV CONTD.

RUN ID F-04

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

DEAD TIME= 26.0 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.841	0.0000D 00	110.	0.0000D 00	130.	0.0000D 00	1.00	130.
0.1000D-02	1.00	-1.91	0.999	-0.4770D-01	1.00	-0.1430D-01	1.00	130.
0.2000D-02	1.00	-3.83	0.995	-0.9530D-01	0.999	-0.2870D-01	1.00	130.
0.3000D-02	1.00	-5.74	0.989	-0.143	0.998	-0.4300D-01	0.999	130.
0.4000D-02	1.00	-7.66	0.980	-0.190	0.997	-0.5730D-01	0.999	130.
0.5000D-02	1.00	-9.57	0.969	-0.236	0.996	-0.7150D-01	0.998	130.
0.6000D-02	0.999	-11.5	0.956	-0.282	0.994	-0.8570D-01	0.997	130.
0.7000D-02	0.999	-13.4	0.941	-0.327	0.991	-0.9980D-01	0.996	130.
0.8000D-02	0.999	-15.3	0.923	-0.370	0.989	-0.114	0.995	130.
0.9000D-02	0.999	-17.2	0.903	-0.413	0.986	-0.128	0.994	130.
0.1000D-01	0.998	-19.1	0.880	-0.455	0.983	-0.142	0.993	130.
0.2000D-01	0.993	-38.2	0.561	-0.786	0.933	-0.272	0.972	127.
0.3000D-01	0.986	-57.2	0.141	-0.914	0.857	-0.382	0.938	122.
0.4000D-01	0.976	-76.0	-0.262	-0.833	0.763	-0.466	0.894	117.
0.5000D-01	0.967	-94.7	-0.556	-0.596	0.662	-0.522	0.843	110.
0.6000D-01	0.959	-113.	-0.698	-0.286	0.562	-0.551	0.787	103.
0.7000D-01	0.952	-132.	-0.696	0.2080D-01	0.472	-0.558	0.731	95.4
0.8000D-01	0.946	-151.	-0.582	0.271	0.394	-0.550	0.677	88.3
0.9000D-01	0.945	-170.	-0.399	0.439	0.331	-0.534	0.628	81.9
0.100	0.939	171.	-0.186	0.517	0.281	-0.514	0.586	76.4
0.200	0.728	-15.0	-0.4700D-01	-0.248	0.2600D-01	-0.346	0.347	45.3
0.300	0.484	160.	0.5950D-01	0.106	-0.4040D-01	-0.249	0.252	32.9
0.400	0.303	-21.6	-0.4100D-01	-0.4260D-01	-0.7390D-01	-0.181	0.195	25.5
0.500	0.171	158.	0.2280D-01	0.1510D-01	-0.9040D-01	-0.132	0.160	20.9
0.600	0.6030D-01	1.89	-0.6010D-02	-0.5740D-02	-0.103	-0.9190D-01	0.138	18.0
0.700	0.5640D-01	-163.	0.4450D-02	0.4380D-02	-0.9860D-01	-0.5050D-01	0.111	14.5
0.800	0.3300D-01	-4.02	-0.3010D-02	-0.6090D-03	-0.8970D-01	-0.2480D-01	0.9300D-01	12.1
0.900	0.2010D-01	77.7	-0.2610D-03	-0.1500D-02	-0.7570D-01	-0.3170D-02	0.7570D-01	9.68
1.00	0.1040D-01	129.	0.3320D-03	-0.5610D-03	-0.6180D-01	0.9540D-02	0.6260D-01	8.16

TABLE XXV

RUN ID F-04

CONTD.

DEAD TIME= 26.0 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.148	-66.1	0.922D-03	0.486D-03	-0.473D-03	0.705D-02	0.707D-02	0.922
3.00	0.904	-44.6	0.945D-03	-0.135D-03	0.849D-03	0.627D-03	0.106D-02	0.138
4.00	0.292	-126.	-0.503D-04	0.130D-03	-0.256D-03	-0.403D-03	0.477D-03	0.623D-01
5.00	2.36	99.9	-0.251D-03	-0.740D-03	-0.286D-03	0.157D-03	0.328D-03	0.428D-01
6.00	0.249	-149.	0.598D-04	0.527D-04	-0.316D-03	-0.579D-04	0.321D-03	0.419D-01
7.00	0.365	93.6	0.363D-05	-0.113D-03	-0.310D-03	0.929D-05	0.310D-03	0.404D-01
8.00	0.389	-120.	0.543D-04	0.137D-03	-0.374D-03	-0.581D-04	0.379D-03	0.494D-01
9.00	0.150	45.1	-0.382D-04	-0.238D-05	-0.190D-03	0.169D-03	0.254D-03	0.332D-01
10.0	0.145	-104.	0.200D-04	-0.828D-05	0.216D-04	0.148D-03	0.150D-03	0.196D-01

TABLE XXVI

RUN ID F-05

COMMENTS F- 12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.25	0.0000D 00	211.	0.0000D 00	169.	0.0000D 00	1.00	169.
0.1000D-02	1.00	-0.377	1.00	-0.2040D-01	1.00	-0.1380D-01	1.00	169.
0.2000D-02	1.00	-0.755	0.999	-0.4070D-01	0.999	-0.2760D-01	1.00	169.
0.3000D-02	1.00	-1.13	0.998	-0.6100D-01	0.999	-0.4130D-01	0.999	169.
0.4000D-02	1.00	-1.51	0.996	-0.8130D-01	0.997	-0.5510D-01	0.999	169.
0.5000D-02	1.00	-1.89	0.993	-0.101	0.996	-0.6870D-01	0.998	169.
0.6000D-02	1.00	-2.26	0.990	-0.122	0.994	-0.8240D-01	0.998	169.
0.7000D-02	1.00	-2.64	0.987	-0.142	0.992	-0.9600D-01	0.997	168.
0.8000D-02	1.00	-3.02	0.982	-0.161	0.990	-0.109	0.996	168.
0.9000D-02	1.00	-3.40	0.978	-0.181	0.987	-0.123	0.995	168.
0.1000D-01	0.999	-3.78	0.973	-0.201	0.984	-0.136	0.994	168.
0.2000D-01	0.998	-7.55	0.894	-0.383	0.939	-0.263	0.975	165.
0.3000D-01	0.994	-11.3	0.775	-0.533	0.869	-0.372	0.946	160.
0.4000D-01	0.990	-15.1	0.630	-0.640	0.783	-0.458	0.907	153.
0.5000D-01	0.984	-18.9	0.474	-0.703	0.688	-0.520	0.862	146.
0.6000D-01	0.976	-22.7	0.323	-0.725	0.592	-0.557	0.813	137.
0.7000D-01	0.967	-26.4	0.186	-0.713	0.501	-0.575	0.762	129.
0.8000D-01	0.957	-30.1	0.7030D-01	-0.678	0.419	-0.577	0.713	120.
0.9000D-01	0.946	-33.7	-0.2420D-01	-0.629	0.347	-0.567	0.665	112.
0.100	0.935	-37.2	-0.9880D-01	-0.573	0.286	-0.552	0.621	105.
0.200	0.784	-76.5	-0.260	-0.8140D-01	0.2310D-01	-0.347	0.348	58.8
0.300	0.548	-112.	-0.114	0.6950D-01	-0.4050D-01	-0.240	0.243	41.1
0.400	0.339	-143.	-0.1720D-01	0.6270D-01	-0.7050D-01	-0.179	0.192	32.4
0.500	0.183	-170.	0.1180D-01	0.2790D-01	-0.9050D-01	-0.139	0.166	28.0
0.600	0.9530D-01	174.	0.1040D-01	0.7980D-02	-0.100	-0.9420D-01	0.137	23.2
0.700	0.4910D-01	157.	0.5850D-02	0.7030D-03	-0.104	-0.5990D-01	0.120	20.3
0.800	0.3130D-01	150.	0.3120D-02	-0.7450D-03	-0.9850D-01	-0.2870D-01	0.103	17.3
0.900	0.1980D-01	82.3	-0.1040D-03	-0.1740D-02	-0.8750D-01	-0.6500D-02	0.8770D-01	14.8
1.00	0.1360D-01	24.0	-0.9720D-03	-0.2380D-03	-0.7240D-01	0.1310D-01	0.7360D-01	12.4

TABLE XXVI

RUN ID F-05

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.222D-01	89.7	-0.272D-03	0.974D-04	0.433D-02	0.123D-01	0.130D-01	2.20
3.00	0.131	-43.2	0.189D-03	-0.232D-03	0.226D-02	-0.302D-03	0.228D-02	0.385
4.00	0.850D-01	150.	0.543D-04	0.315D-04	-0.372D-03	-0.639D-03	0.739D-03	0.125
5.00	0.213	79.7	-0.914D-04	-0.854D-05	-0.114D-03	0.406D-03	0.422D-03	0.713D-01
6.00	1.21	-129.	-0.896D-04	-0.103D-04	0.527D-04	-0.525D-04	0.744D-04	0.126D-01
7.00	0.307	72.1	0.136D-04	-0.916D-04	-0.270D-03	-0.134D-03	0.301D-03	0.509D-01
8.00	0.433	105.	-0.765D-04	-0.984D-04	-0.176D-03	0.228D-03	0.288D-03	0.486D-01
9.00	0.915D-01	35.0	-0.164D-04	0.325D-04	0.565D-04	0.394D-03	0.398D-03	0.673D-01
10.0	0.151	-98.5	-0.160D-04	-0.899D-06	0.216D-04	-0.104D-03	0.106D-03	0.180D-01

TABLE XXVI CONTD.

RUN ID F-05

COMMENTS F- 12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

DEAD TIME= 25.8 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.25	0.0000D 00	211.	0.0000D 00	169.	0.0000D 00	1.00	169.
0.1000D-02	1.00	-1.86	0.999	-0.4620D-01	1.00	-0.1380D-01	1.00	169.
0.2000D-02	1.00	-3.71	0.995	-0.9220D-01	0.999	-0.2760D-01	1.00	169.
0.3000D-02	1.00	-5.57	0.990	-0.138	0.999	-0.4130D-01	0.999	169.
0.4000D-02	1.00	-7.42	0.982	-0.183	0.997	-0.5510D-01	0.999	169.
0.5000D-02	1.00	-9.28	0.972	-0.228	0.996	-0.6870D-01	0.998	169.
0.6000D-02	1.00	-11.1	0.959	-0.273	0.994	-0.8240D-01	0.998	169.
0.7000D-02	1.00	-13.0	0.945	-0.316	0.992	-0.9600D-01	0.997	168.
0.8000D-02	1.00	-14.8	0.928	-0.359	0.990	-0.109	0.996	168.
0.9000D-02	1.00	-16.7	0.910	-0.401	0.987	-0.123	0.995	168.
0.1000D-01	0.999	-18.6	0.889	-0.442	0.984	-0.136	0.994	168.
0.2000D-01	0.998	-37.1	0.589	-0.774	0.939	-0.263	0.975	165.
0.3000D-01	0.994	-55.7	0.182	-0.923	0.869	-0.372	0.946	160.
0.4000D-01	0.990	-74.3	-0.226	-0.869	0.783	-0.458	0.907	153.
0.5000D-01	0.984	-92.8	-0.544	-0.650	0.688	-0.520	0.862	146.
0.6000D-01	0.976	-111.	-0.717	-0.339	0.592	-0.557	0.813	137.
0.7000D-01	0.967	-130.	-0.737	-0.1510D-01	0.501	-0.575	0.762	129.
0.8000D-01	0.957	-148.	-0.630	0.259	0.419	-0.577	0.713	120.
0.9000D-01	0.946	-167.	-0.443	0.447	0.347	-0.567	0.665	112.
0.100	0.935	175.	-0.221	0.537	0.286	-0.552	0.621	105.
0.200	0.784	-12.1	-0.3930D-01	-0.270	0.2310D-01	-0.347	0.348	58.8
0.300	0.548	165.	0.5610D-01	0.121	-0.4050D-01	-0.240	0.243	41.1
0.400	0.339	-14.4	-0.3820D-01	-0.5260D-01	-0.7050D-01	-0.179	0.192	32.4
0.500	0.183	171.	0.2030D-01	0.2240D-01	-0.9050D-01	-0.139	0.166	28.0
0.600	0.9530D-01	7.34	-0.8310D-02	-0.1010D-01	-0.100	-0.9420D-01	0.137	23.2
0.700	0.4910D-01	-158.	0.3620D-02	0.4650D-02	-0.104	-0.5990D-01	0.120	20.3
0.800	0.3130D-01	47.8	-0.1410D-02	-0.2890D-02	-0.9850D-01	-0.2870D-01	0.103	17.3
0.900	0.1980D-01	-168.	0.1670D-02	0.4840D-03	-0.8750D-01	-0.6500D-02	0.8770D-01	14.8
1.00	0.1360D-01	-14.2	-0.9110D-03	0.4150D-03	-0.7240D-01	0.1310D-01	0.7360D-01	12.4

TABLE XXVI
7

RUN ID F-05

CONTD.

DEAD TIME= 25.8 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.222D-01	13.3	0.311D-04	0.287D-03	0.433D-02	0.123D-01	0.130D-01	2.20
3.00	0.131	-158.	-0.289D-03	-0.749D-04	0.226D-02	-0.302D-03	0.228D-02	0.385
4.00	0.850D-01	-2.59	-0.340D-04	-0.528D-04	-0.372D-03	-0.639D-03	0.739D-03	0.125
5.00	0.218	-111.	0.913D-04	-0.931D-05	-0.114D-03	0.406D-03	0.422D-03	0.713D-01
6.00	1.21	2.06	0.661D-04	-0.613D-04	0.527D-04	-0.525D-04	0.744D-04	0.126D-01
7.00	0.307	164.	0.909D-04	0.174D-04	-0.270D-03	-0.134D-03	0.301D-03	0.509D-01
8.00	0.433	159.	0.350D-04	-0.120D-03	-0.176D-03	0.228D-03	0.288D-03	0.486D-01
9.00	0.915D-01	50.9	-0.247D-04	0.268D-04	0.565D-04	0.394D-03	0.398D-03	0.673D-01
10.0	0.151	-121.	-0.152D-04	0.526D-05	0.216D-04	-0.104D-03	0.106D-03	0.180D-01

TABLE XXVII

RUN ID F-06

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.971	0.0000D 00	184.	0.0000D 00	189.	0.0000D 00	1.00	189.
0.1000D-02	1.00	-0.242	1.00	-0.2010D-01	1.00	-0.1590D-01	1.00	189.
0.2000D-02	1.00	-0.484	0.999	-0.4030D-01	0.999	-0.3180D-01	1.00	189.
0.3000D-02	1.00	-0.727	0.998	-0.6030D-01	0.998	-0.4760D-01	0.999	189.
0.4000D-02	1.00	-0.971	0.996	-0.8040D-01	0.996	-0.6340D-01	0.998	189.
0.5000D-02	1.00	-1.22	0.993	-0.100	0.994	-0.7910D-01	0.997	189.
0.6000D-02	1.00	-1.46	0.990	-0.120	0.992	-0.9480D-01	0.996	189.
0.7000D-02	1.00	-1.71	0.987	-0.140	0.989	-0.110	0.995	188.
0.8000D-02	1.00	-1.96	0.983	-0.160	0.985	-0.126	0.993	188.
0.9000D-02	1.00	-2.21	0.978	-0.179	0.981	-0.141	0.991	188.
0.1000D-01	1.00	-2.46	0.973	-0.198	0.977	-0.156	0.989	187.
0.2000D-01	1.02	-5.16	0.897	-0.380	0.913	-0.293	0.959	182.
0.3000D-01	1.03	-8.28	0.780	-0.529	0.821	-0.398	0.913	173.
0.4000D-01	1.05	-12.0	0.637	-0.638	0.719	-0.469	0.858	163.
0.5000D-01	1.06	-16.2	0.482	-0.703	0.620	-0.508	0.802	152.
0.6000D-01	1.07	-20.8	0.331	-0.727	0.532	-0.527	0.749	142.
0.7000D-01	1.06	-25.4	0.192	-0.718	0.455	-0.535	0.702	133.
0.8000D-01	1.04	-29.7	0.7420D-01	-0.683	0.387	-0.535	0.661	125.
0.9000D-01	1.02	-33.4	-0.2200D-01	-0.633	0.324	-0.531	0.622	118.
0.100	0.999	-36.6	-0.9730D-01	-0.575	0.265	-0.520	0.584	111.
0.200	0.876	-76.3	-0.262	-0.8610D-01	0.2450D-01	-0.313	0.314	59.5
0.300	0.598	-114.	-0.117	0.6930D-01	-0.2760D-01	-0.226	0.228	43.1
0.400	0.404	-144.	-0.1820D-01	0.6670D-01	-0.5970D-01	-0.161	0.171	32.4
0.500	0.236	-178.	0.1440D-01	0.2980D-01	-0.6580D-01	-0.124	0.140	26.6
0.600	0.113	156.	0.1230D-01	0.5600D-02	-0.7910D-01	-0.8980D-01	0.120	22.7
0.700	0.6250D-01	128.	0.6130D-02	-0.1580D-02	-0.7980D-01	-0.6240D-01	0.101	19.2
0.800	0.4430D-01	100.	0.2270D-02	-0.3020D-02	-0.7640D-01	-0.3830D-01	0.8550D-01	16.2
0.900	0.1280D-01	66.1	-0.1160D-03	-0.8840D-03	-0.6700D-01	-0.1970D-01	0.6980D-01	13.2
1.00	0.2370D-01	84.2	0.1880D-04	-0.1440D-02	-0.6030D-01	-0.6920D-02	0.6070D-01	11.5

TABLE XXVII

RUN ID F-06

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.274D-01	155.	-0.242D-04	-0.277D-03	-0.341D-02	0.956D-02	0.102D-01	1.92
3.00	0.345	-98.6	0.504D-03	-0.312D-03	0.675D-03	0.158D-02	0.172D-02	0.326
4.00	3.50	85.7	-0.606D-03	-0.173D-03	-0.624D-04	0.169D-03	0.180D-03	0.341D-01
5.00	0.345	-43.4	-0.740D-04	0.965D-05	-0.175D-03	-0.127D-03	0.216D-03	0.410D-01
6.00	1.50	-21.2	-0.179D-03	0.804D-04	-0.131D-03	0.685D-05	0.131D-03	0.249D-01
7.00	0.311	-30.3	-0.122D-03	-0.436D-04	-0.267D-03	-0.318D-03	0.416D-03	0.787D-01
8.00	0.649	44.0	-0.156D-03	-0.105D-03	-0.286D-03	0.513D-04	0.290D-03	0.550D-01
9.00	0.286	16.8	-0.445D-04	0.669D-04	-0.816D-04	0.269D-03	0.281D-03	0.533D-01
10.0	0.447	152.	-0.131D-04	0.140D-04	0.406D-04	-0.141D-04	0.430D-04	0.814D-02

TABLE XXVII CONTD.

RUN ID F-06

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

DEAD TIME= 26.0 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.971	0.0000D 00	184.	0.0000D 00	189.	0.0000D 00	1.00	189.
0.1000D-02	1.00	-1.73	0.999	-0.461D-01	1.00	-0.159D-01	1.00	189.
0.2000D-02	1.00	-3.46	0.995	-0.921D-01	0.999	-0.318D-01	1.00	189.
0.3000D-02	1.00	-5.20	0.990	-0.138	0.998	-0.476D-01	0.999	189.
0.4000D-02	1.00	-6.93	0.982	-0.183	0.996	-0.634D-01	0.998	189.
0.5000D-02	1.00	-8.66	0.972	-0.228	0.994	-0.791D-01	0.997	189.
0.6000D-02	1.00	-10.4	0.960	-0.273	0.992	-0.948D-01	0.996	189.
0.7000D-02	1.00	-12.1	0.945	-0.316	0.989	-0.110	0.995	188.
0.8000D-02	1.00	-13.9	0.929	-0.359	0.985	-0.126	0.993	188.
0.9000D-02	1.00	-15.6	0.910	-0.401	0.981	-0.141	0.991	188.
0.1000D-01	1.00	-17.4	0.890	-0.442	0.977	-0.156	0.989	187.
0.2000D-01	1.02	-34.9	0.590	-0.775	0.913	-0.293	0.959	182.
0.3000D-01	1.03	-53.0	0.182	-0.925	0.821	-0.398	0.913	173.
0.4000D-01	1.05	-71.6	-0.228	-0.872	0.719	-0.469	0.858	163.
0.5000D-01	1.06	-90.7	-0.549	-0.653	0.620	-0.508	0.802	152.
0.6000D-01	1.07	-110.	-0.724	-0.339	0.532	-0.527	0.749	142.
0.7000D-01	1.06	-130.	-0.743	-0.955D-02	0.455	-0.535	0.702	133.
0.8000D-01	1.04	-149.	-0.632	0.268	0.387	-0.535	0.661	125.
0.9000D-01	1.02	-167.	-0.439	0.456	0.324	-0.531	0.622	118.
0.100	0.999	174.	-0.213	0.543	0.265	-0.520	0.584	111.
0.200	0.876	-14.2	-0.465D-01	-0.271	0.245D-01	-0.313	0.314	59.5
0.300	0.598	159.	0.628D-01	0.121	-0.276D-01	-0.226	0.228	43.1
0.400	0.404	-20.2	-0.450D-01	-0.525D-01	-0.597D-01	-0.161	0.171	32.4
0.500	0.236	157.	0.256D-01	0.210D-01	-0.658D-01	-0.124	0.140	26.6
0.600	0.113	-18.0	-0.117D-01	-0.690D-02	-0.791D-01	-0.898D-01	0.120	22.7
0.700	0.625D-01	165.	0.584D-02	0.245D-02	-0.798D-01	-0.624D-01	0.101	19.2
0.800	0.443D-01	-11.4	-0.365D-02	-0.992D-03	-0.764D-01	-0.383D-01	0.855D-01	16.2
0.900	0.128D-01	165.	0.891D-03	0.283D-04	-0.670D-01	-0.197D-01	0.698D-01	13.2
1.00	0.237D-01	34.5	-0.109D-02	-0.947D-03	-0.603D-01	-0.692D-02	0.607D-01	11.5

TABLE XXVII

RUN ID F-06

CONTD.

DEAD TIME= 26.0 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.274D-01	56.0	-0.270D-03	0.691D-04	-0.341D-02	0.956D-02	0.102D-01	1.92
3.00	0.345	112.	-0.593D-03	0.799D-05	0.675D-03	0.158D-02	0.172D-02	0.326
4.00	3.50	-113.	0.629D-03	-0.309D-04	-0.624D-04	0.169D-03	0.180D-03	0.341D-01
5.00	0.345	68.1	0.182D-04	-0.724D-04	-0.175D-03	-0.127D-03	0.216D-03	0.410D-01
6.00	1.50	40.7	-0.155D-03	-0.120D-03	-0.131D-03	0.685D-05	0.131D-03	0.249D-01
7.00	0.311	-18.1	-0.110D-03	-0.683D-04	-0.267D-03	-0.318D-03	0.416D-03	0.787D-01
8.00	0.649	6.51	-0.188D-03	0.121D-04	-0.286D-03	0.513D-04	0.290D-03	0.550D-01
9.00	0.286	-70.4	0.647D-04	0.477D-04	-0.816D-04	0.269D-03	0.281D-03	0.533D-01
10.0	0.447	15.5	0.192D-04	-0.124D-05	0.406D-04	-0.141D-04	0.430D-04	0.814D-02

ORTRAN ** STOP

TABLE XXVIII

RUN ID F-07

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SHP LOOP 3 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.849	0.0000D 00	302.	0.0000D 00	356.	0.0000D 00	1.00	356.
0.1000D-02	1.00	-0.312	1.00	-0.1810D-01	1.00	-0.1270D-01	1.00	356.
0.2000D-02	1.00	-0.625	0.999	-0.3620D-01	0.999	-0.2530D-01	1.00	356.
0.3000D-02	1.00	-0.937	0.998	-0.5430D-01	0.999	-0.3790D-01	0.999	356.
0.4000D-02	1.00	-1.25	0.996	-0.7230D-01	0.998	-0.5060D-01	0.999	356.
0.5000D-02	1.00	-1.56	0.994	-0.9020D-01	0.997	-0.6310D-01	0.999	355.
0.6000D-02	0.999	-1.87	0.991	-0.108	0.995	-0.7570D-01	0.998	355.
0.7000D-02	0.999	-2.18	0.988	-0.126	0.993	-0.8820D-01	0.997	355.
0.8000D-02	0.999	-2.49	0.985	-0.143	0.991	-0.101	0.996	355.
0.9000D-02	0.998	-2.80	0.981	-0.161	0.989	-0.113	0.995	354.
0.1000D-01	0.998	-3.11	0.976	-0.178	0.986	-0.125	0.994	354.
0.2000D-01	0.993	-6.14	0.909	-0.340	0.947	-0.243	0.977	348.
0.3000D-01	0.985	-9.02	0.808	-0.473	0.885	-0.346	0.950	338.
0.4000D-01	0.976	-11.7	0.687	-0.570	0.807	-0.429	0.914	325.
0.5000D-01	0.968	-14.2	0.560	-0.631	0.720	-0.490	0.871	310.
0.6000D-01	0.962	-16.5	0.437	-0.661	0.630	-0.530	0.823	293.
0.7000D-01	0.960	-18.9	0.324	-0.668	0.544	-0.549	0.773	275.
0.8000D-01	0.961	-21.3	0.224	-0.658	0.466	-0.553	0.723	257.
0.9000D-01	0.964	-24.0	0.137	-0.636	0.398	-0.545	0.675	240.
0.100	0.967	-27.0	0.620D-01	-0.607	0.342	-0.530	0.631	224.
0.200	0.845	-55.1	-0.224	-0.236	0.773D-01	-0.378	0.385	137.
0.300	0.693	-80.8	-0.193	-0.278D-01	-0.512D-02	-0.282	0.282	100.
0.400	0.538	-106.	-0.108	0.561D-01	-0.463D-01	-0.221	0.226	80.4
0.500	0.401	-128.	-0.368D-01	0.657D-01	-0.729D-01	-0.173	0.188	66.8
0.600	0.279	-151.	0.479D-02	0.446D-01	-0.916D-01	-0.132	0.161	57.2
0.700	0.178	-176.	0.170D-01	0.178D-01	-0.102	-0.933D-01	0.138	49.1
0.800	0.115	164.	0.128D-01	0.398D-02	-0.984D-01	-0.634D-01	0.117	41.7
0.900	0.442D-01	141.	0.427D-02	-0.132D-02	-0.941D-01	-0.372D-01	0.101	36.0
1.00	0.102D-01	122.	0.586D-03	-0.635D-03	-0.637D-01	-0.154D-01	0.851D-01	30.3

TABLE XXVIII

RUN ID F-07

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.631D-01	144.	-0.312D-03	-0.111D-02	-0.622D-02	0.171D-01	0.182D-01	6.49
3.00	0.131	-53.5	0.454D-03	0.787D-04	0.158D-02	0.316D-02	0.353D-02	1.26
4.00	0.161	65.0	0.168D-04	0.129D-03	0.772D-03	0.245D-03	0.810D-03	0.288
5.00	0.249	87.7	0.867D-04	-0.533D-04	-0.200D-03	-0.357D-03	0.409D-03	0.146
6.00	1.24	124.	0.149D-03	-0.353D-03	-0.304D-03	0.575D-04	0.309D-03	0.110
7.00	1.86	-16.8	0.212D-03	0.220D-03	0.751D-04	0.146D-03	0.164D-03	0.585D-01
8.00	0.173	-50.7	-0.174D-04	-0.226D-04	0.373D-04	-0.160D-03	0.165D-03	0.586D-01
9.00	1.46	-33.6	-0.152D-04	-0.836D-04	0.230D-04	-0.534D-04	0.581D-04	0.207D-01
10.0	0.608	28.5	-0.481D-04	-0.964D-04	-0.145D-03	-0.102D-03	0.177D-03	0.631D-01

TABLE XXVIII CONTD.

RUN ID F-07

COMMENTS F-12 PACKED RED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 12.8 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.849	0.0000D 00	302.	0.0000D 00	356.	0.0000D 00	1.00	356.
0.1000D-02	1.00	-1.05	0.999	-0.3090D-01	1.00	-0.1270D-01	1.00	356.
0.2000D-02	1.00	-2.09	0.998	-0.6180D-01	0.999	-0.2530D-01	1.00	356.
0.3000D-02	1.00	-3.14	0.995	-0.9250D-01	0.999	-0.3790D-01	0.999	356.
0.4000D-02	1.00	-4.18	0.991	-0.123	0.998	-0.5060D-01	0.999	356.
0.5000D-02	1.00	-5.23	0.986	-0.154	0.997	-0.6310D-01	0.999	355.
0.6000D-02	0.999	-6.27	0.980	-0.184	0.995	-0.7570D-01	0.998	355.
0.7000D-02	0.999	-7.32	0.973	-0.214	0.993	-0.8820D-01	0.997	355.
0.8000D-02	0.999	-8.36	0.965	-0.243	0.991	-0.101	0.996	355.
0.9000D-02	0.998	-9.40	0.956	-0.273	0.989	-0.113	0.995	354.
0.1000D-01	0.998	-10.4	0.946	-0.301	0.986	-0.125	0.994	354.
0.2000D-01	0.993	-20.8	0.793	-0.559	0.947	-0.243	0.977	348.
0.3000D-01	0.985	-31.0	0.572	-0.741	0.885	-0.346	0.950	338.
0.4000D-01	0.976	-41.0	0.320	-0.833	0.807	-0.429	0.914	325.
0.5000D-01	0.968	-50.9	0.7190D-01	-0.840	0.720	-0.490	0.871	310.
0.6000D-01	0.962	-60.5	-0.145	-0.779	0.630	-0.530	0.823	293.
0.7000D-01	0.960	-70.2	-0.319	-0.670	0.544	-0.549	0.773	275.
0.8000D-01	0.961	-80.0	-0.445	-0.534	0.466	-0.553	0.723	257.
0.9000D-01	0.964	-90.0	-0.525	-0.384	0.398	-0.545	0.675	240.
0.100	0.967	-100.	-0.563	-0.233	0.342	-0.530	0.631	224.
0.200	0.845	158.	0.5770D-01	0.321	0.7730D-01	-0.378	0.385	137.
0.300	0.693	59.2	0.166	-0.103	-0.5120D-02	-0.282	0.282	100.
0.400	0.538	-39.0	-0.9420D-01	-0.7680D-01	-0.4630D-01	-0.221	0.226	80.4
0.500	0.401	-135.	-0.2890D-01	0.6950D-01	-0.7290D-01	-0.173	0.188	66.8
0.600	0.279	129.	0.4480D-01	0.3010D-02	-0.9160D-01	-0.132	0.161	57.2
0.700	0.178	30.4	-0.7220D-02	-0.2350D-01	-0.102	-0.9330D-01	0.138	49.1
0.800	0.115	-62.2	-0.1170D-01	0.6620D-02	-0.9840D-01	-0.6340D-01	0.117	41.7
0.900	0.442D-01	-159.	0.3290D-02	0.3040D-02	-0.9410D-01	-0.3720D-01	0.101	36.0
1.00	0.102D-01	109.	0.4230D-03	-0.7540D-03	-0.8370D-01	-0.1540D-01	0.851D-01	30.3

TABLE XXVIII

RUN ID F-07

CONTD.

DEAD TIME= 12.8 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.631D-01	118.	-0.777D-03	-0.849D-03	-0.622D-02	0.171D-01	0.182D-01	6.49
3.00	0.131	-93.7	0.398D-03	-0.233D-03	0.158D-02	0.316D-02	0.353D-02	1.26
4.00	0.161	11.4	0.114D-03	0.633D-04	0.772D-03	0.245D-03	0.810D-03	0.288
5.00	0.249	20.8	-0.151D-04	-0.101D-03	-0.200D-03	-0.357D-03	0.409D-03	0.146
6.00	1.24	43.3	-0.323D-03	-0.206D-03	-0.304D-03	0.575D-04	0.309D-03	0.110
7.00	1.86	-110.	0.206D-03	-0.226D-03	0.751D-04	0.146D-03	0.164D-03	0.585D-01
8.00	0.173	-158.	-0.165D-04	0.232D-04	0.373D-04	-0.160D-03	0.165D-03	0.586D-01
9.00	1.46	-154.	-0.644D-04	0.555D-04	0.230D-04	-0.534D-04	0.581D-04	0.207D-01
10.0	0.608	-105.	-0.362D-04	0.101D-03	-0.145D-03	-0.102D-03	0.177D-03	0.631D-01

ORTRAN ** STOP

TABLE XXIX

RUN ID F-09

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 4 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.53	0.0000D 00	671.	0.0000D 00	439.	0.0000D 00	1.00	439.
0.1000D-02	1.00	-0.261	1.00	-0.175D-01	1.00	-0.130D-01	1.00	439.
0.2000D-02	1.00	-0.522	0.999	-0.350D-01	0.999	-0.259D-01	1.00	439.
0.3000D-02	1.00	-0.782	0.998	-0.525D-01	0.999	-0.389D-01	0.999	439.
0.4000D-02	1.00	-1.04	0.996	-0.699D-01	0.998	-0.518D-01	0.999	439.
0.5000D-02	1.00	-1.30	0.994	-0.873D-01	0.996	-0.647D-01	0.998	439.
0.6000D-02	0.999	-1.56	0.992	-0.105	0.995	-0.775D-01	0.998	438.
0.7000D-02	0.999	-1.82	0.989	-0.122	0.993	-0.903D-01	0.997	438.
0.8000D-02	0.999	-2.08	0.985	-0.139	0.991	-0.103	0.996	437.
0.9000D-02	0.999	-2.34	0.981	-0.156	0.988	-0.116	0.995	437.
0.1000D-01	0.998	-2.59	0.977	-0.172	0.985	-0.128	0.994	436.
0.2000D-01	0.994	-5.08	0.912	-0.328	0.943	-0.247	0.975	428.
0.3000D-01	0.988	-7.39	0.816	-0.454	0.878	-0.349	0.945	415.
0.4000D-01	0.984	-9.52	0.704	-0.547	0.798	-0.430	0.906	398.
0.5000D-01	0.982	-11.5	0.587	-0.608	0.710	-0.488	0.861	378.
0.6000D-01	0.983	-13.5	0.474	-0.643	0.622	-0.523	0.813	357.
0.7000D-01	0.988	-15.7	0.369	-0.659	0.540	-0.541	0.764	336.
0.8000D-01	0.994	-18.1	0.272	-0.658	0.466	-0.545	0.717	315.
0.9000D-01	0.998	-20.8	0.184	-0.646	0.402	-0.539	0.673	295.
0.100	0.998	-23.6	0.106	-0.622	0.347	-0.529	0.632	278.
0.200	0.954	-49.6	-0.223	-0.285	0.760D-01	-0.372	0.380	167.
0.300	0.842	-76.4	-0.227	-0.509D-01	-0.432D-02	-0.276	0.276	121.
0.400	0.684	-101.	-0.138	0.596D-01	-0.461D-01	-0.215	0.220	96.6
0.500	0.522	-124.	-0.525D-01	0.833D-01	-0.761D-01	-0.173	0.189	82.9
0.600	0.390	-147.	0.244D-02	0.627D-01	-0.922D-01	-0.132	0.161	70.7
0.700	0.278	-167.	0.215D-01	0.317D-01	-0.101	-0.939D-01	0.138	60.5
0.800	0.184	175.	0.199D-01	0.989D-02	-0.103	-0.621D-01	0.121	53.0
0.900	0.117	153.	0.119D-01	-0.154D-02	-0.968D-01	-0.340D-01	0.103	45.1
1.00	0.757D-01	142.	0.574D-02	-0.328D-02	-0.864D-01	-0.124D-01	0.873D-01	38.3

TABLE XXIX

RUN ID F-09

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.204D-01	36.5	-0.286D-03	0.191D-03	-0.569D-02	0.159D-01	0.168D-01	7.40
3.00	0.137	-144.	-0.326D-04	-0.335D-03	0.161D-02	0.184D-02	0.245D-02	1.08
4.00	0.340	-83.6	-0.370D-04	-0.211D-03	0.607D-03	-0.178D-03	0.632D-03	0.278
5.00	0.646	130.	-0.125D-03	0.874D-04	0.228D-03	0.616D-04	0.236D-03	0.104
6.00	0.120	-173.	-0.457D-04	-0.329D-04	0.412D-03	0.224D-03	0.469D-03	0.206
7.00	0.227	42.5	-0.859D-04	-0.570D-04	-0.449D-03	0.709D-04	0.455D-03	0.200
8.00	0.961D-01	35.2	-0.538D-04	-0.328D-04	-0.655D-03	0.441D-04	0.656D-03	0.288
9.00	0.747D-01	110.	-0.519D-05	-0.349D-04	-0.414D-03	0.228D-03	0.473D-03	0.208
10.0	0.722D-01	-2.60	0.960D-05	-0.772D-05	0.138D-03	-0.101D-03	0.171D-03	0.750D-01

TABLE XXIX CONTD.

RUN ID F-09

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 4 LINE APP 1/7/69

DEAD TIME= 11.2 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.53	0.0000D 00	671.	0.0000D 00	439.	0.0000D 00	1.00	439.
0.1000D-02	1.00	-0.903	1.00	-0.2870D-01	1.00	-0.1300D-01	1.00	439.
0.2000D-02	1.00	-1.81	0.998	-0.5740D-01	0.999	-0.2590D-01	1.00	439.
0.3000D-02	1.00	-2.71	0.996	-0.8600D-01	0.999	-0.3890D-01	0.999	439.
0.4000D-02	1.00	-3.61	0.992	-0.114	0.998	-0.5180D-01	0.999	439.
0.5000D-02	1.00	-4.51	0.988	-0.143	0.996	-0.6470D-01	0.998	439.
0.6000D-02	0.999	-5.41	0.982	-0.171	0.995	-0.7750D-01	0.998	438.
0.7000D-02	0.999	-6.31	0.976	-0.199	0.993	-0.9030D-01	0.997	438.
0.8000D-02	0.999	-7.21	0.969	-0.226	0.991	-0.103	0.996	437.
0.9000D-02	0.999	-8.11	0.961	-0.254	0.988	-0.116	0.995	437.
0.1000D-01	0.998	-9.01	0.951	-0.280	0.985	-0.128	0.994	436.
0.2000D-01	0.994	-17.9	0.816	-0.522	0.943	-0.247	0.975	428.
0.3000D-01	0.988	-26.6	0.621	-0.698	0.878	-0.349	0.945	415.
0.4000D-01	0.984	-35.2	0.397	-0.798	0.798	-0.430	0.906	398.
0.5000D-01	0.982	-43.6	0.174	-0.827	0.710	-0.488	0.861	378.
0.6000D-01	0.983	-52.0	-0.2950D-01	-0.799	0.622	-0.523	0.813	357.
0.7000D-01	0.988	-60.6	-0.204	-0.727	0.540	-0.541	0.764	336.
0.8000D-01	0.994	-69.4	-0.344	-0.624	0.466	-0.545	0.717	315.
0.9000D-01	0.998	-78.5	-0.448	-0.500	0.402	-0.539	0.673	295.
0.100	0.998	-87.7	-0.514	-0.367	0.347	-0.529	0.632	278.
0.200	0.954	-178.	-0.8510D-01	0.352	0.7600D-01	-0.372	0.380	167.
0.300	0.842	91.0	0.232	0.5830D-03	-0.4320D-02	-0.276	0.276	121.
0.400	0.684	2.06	-0.2620D-01	-0.148	-0.4610D-01	-0.215	0.220	96.6
0.500	0.522	-84.8	-0.9330D-01	0.3140D-01	-0.7610D-01	-0.173	0.189	82.9
0.600	0.390	-172.	0.2870D-01	0.5580D-01	-0.9220D-01	-0.132	0.161	70.7
0.700	0.278	104.	0.3200D-01	-0.2100D-01	-0.101	-0.9390D-01	0.138	60.5
0.800	0.184	22.0	-0.1340D-01	-0.1780D-01	-0.103	-0.6210D-01	0.121	53.0
0.900	0.117	-64.2	-0.8530D-02	0.8500D-02	-0.9680D-01	-0.3400D-01	0.103	45.1
1.00	0.7570D-01	-140.	0.4380D-02	0.4950D-02	-0.8640D-01	-0.1240D-01	0.8730D-01	38.3

TABLE XXIX

RUN ID F-09

CONTD.

DEAD TIME= 11.2 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.204D-01	-167.	0.186D-03	-0.289D-03	-0.569D-02	0.159D-01	0.168D-01	7.40
3.00	0.137	90.5	-0.255D-03	0.219D-03	0.161D-02	0.184D-02	0.245D-02	1.08
4.00	0.340	-130.	-0.180D-03	-0.118D-03	0.607D-03	-0.178D-03	0.632D-03	0.278
5.00	0.646	161.	-0.152D-03	0.924D-05	0.228D-03	0.616D-04	0.236D-03	0.104
6.00	0.120	-63.0	0.464D-04	-0.319D-04	0.412D-03	0.224D-03	0.469D-03	0.206
7.00	0.227	-129.	0.771D-04	0.684D-04	-0.449D-03	0.709D-04	0.455D-03	0.200
8.00	0.961D-01	-58.5	-0.293D-04	0.559D-04	-0.655D-03	0.441D-04	0.656D-03	0.288
9.00	0.747D-01	94.9	-0.143D-04	-0.323D-04	-0.414D-03	0.228D-03	0.473D-03	0.208
10.0	0.722D-01	60.3	0.112D-04	0.502D-05	0.138D-03	-0.101D-03	0.171D-03	0.750D-01

TABLE XXX

RUN ID F-10

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.992	0.0000D 00	359.	0.0000D 00	361.	0.0000D 00	1.00	361.
0.1000D-02	1.00	-0.272	1.00	-0.177D-01	1.00	-0.129D-01	1.00	361.
0.2000D-02	1.00	-0.543	0.999	-0.353D-01	0.999	-0.259D-01	1.00	361.
0.3000D-02	1.00	-0.815	0.998	-0.530D-01	0.999	-0.388D-01	0.999	361.
0.4000D-02	1.00	-1.09	0.997	-0.705D-01	0.998	-0.516D-01	0.999	361.
0.5000D-02	1.00	-1.36	0.995	-0.881D-01	0.996	-0.645D-01	0.998	361.
0.6000D-02	1.00	-1.63	0.992	-0.106	0.995	-0.772D-01	0.998	360.
0.7000D-02	1.00	-1.90	0.990	-0.123	0.993	-0.900D-01	0.997	360.
0.8000D-02	1.00	-2.18	0.986	-0.140	0.991	-0.103	0.996	360.
0.9000D-02	1.00	-2.45	0.983	-0.157	0.988	-0.115	0.995	359.
0.1000D-01	1.00	-2.72	0.979	-0.175	0.985	-0.128	0.994	359.
0.2000D-01	1.00	-5.48	0.917	-0.336	0.943	-0.246	0.975	352.
0.3000D-01	1.01	-8.32	0.823	-0.474	0.878	-0.349	0.945	341.
0.4000D-01	1.01	-11.3	0.704	-0.581	0.797	-0.429	0.905	327.
0.5000D-01	1.01	-14.3	0.573	-0.654	0.709	-0.486	0.859	310.
0.6000D-01	1.01	-17.5	0.441	-0.693	0.621	-0.520	0.810	293.
0.7000D-01	1.01	-20.9	0.316	-0.702	0.538	-0.536	0.759	274.
0.8000D-01	1.01	-24.3	0.205	-0.689	0.465	-0.538	0.711	257.
0.9000D-01	1.00	-27.7	0.110	-0.659	0.402	-0.531	0.666	241.
0.100	0.993	-31.1	0.315D-01	-0.621	0.350	-0.519	0.626	226.
0.200	0.890	-62.1	-0.254	-0.218	0.829D-01	-0.367	0.376	136.
0.300	0.722	-91.3	-0.199	0.214D-02	0.347D-02	-0.276	0.276	99.7
0.400	0.545	-119.	-0.943D-01	0.761D-01	-0.373D-01	-0.219	0.222	80.4
0.500	0.380	-145.	-0.181D-01	0.694D-01	-0.653D-01	-0.177	0.189	68.2
0.600	0.240	-167.	0.128D-01	0.375D-01	-0.882D-01	-0.140	0.165	59.6
0.700	0.150	171.	0.167D-01	0.126D-01	-0.973D-01	-0.100	0.140	50.5
0.800	0.766D-01	144.	0.926D-02	-0.490D-04	-0.980D-01	-0.707D-01	0.121	43.7
0.900	0.312D-01	160.	0.328D-02	0.259D-03	-0.958D-01	-0.439D-01	0.105	38.1
1.00	0.516D-02	-18.2	-0.460D-03	0.423D-04	-0.872D-01	-0.200D-01	0.894D-01	32.3

TABLE XXX

RUN ID F-10

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.552D-01	-75.4	0.797D-03	0.755D-03	-0.958D-02	0.174D-01	0.199D-01	7.18
3.00	0.239	-141.	0.626D-03	-0.821D-03	0.139D-03	0.432D-02	0.433D-02	1.56
4.00	0.984	150.	-0.225D-03	-0.109D-02	-0.363D-03	0.108D-02	0.114D-02	0.410
5.00	0.635	65.0	-0.695D-03	0.566D-05	-0.455D-03	0.996D-03	0.109D-02	0.395
6.00	0.563	50.8	-0.238D-03	0.314D-03	0.165D-03	0.681D-03	0.700D-03	0.253
7.00	1.45	61.4	0.389D-03	0.366D-03	0.352D-03	-0.115D-03	0.370D-03	0.134
8.00	3.61	-45.4	0.346D-03	-0.247D-03	0.116D-03	0.203D-04	0.118D-03	0.425D-01
9.00	0.667	-103.	0.516D-04	-0.215D-03	0.297D-03	0.146D-03	0.331D-03	0.120
10.0	0.210	-147.	-0.930D-04	-0.435D-04	0.484D-03	-0.658D-04	0.488D-03	0.176

TABLE XXX CONTD.

RUN ID F-10

COMMENTS F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

DEAD TIME= 12.2 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
0.0000D 00	0.992	0.0000D 00	359.	0.0000D 00	361.	0.0000D 00	1.00	361.
0.1000D-02	1.00	-0.971	0.999	-0.299D-01	1.00	-0.129D-01	1.00	361.
0.2000D-02	1.00	-1.94	0.998	-0.597D-01	0.999	-0.259D-01	1.00	361.
0.3000D-02	1.00	-2.91	0.995	-0.894D-01	0.999	-0.388D-01	0.999	361.
0.4000D-02	1.00	-3.88	0.992	-0.119	0.998	-0.516D-01	0.999	361.
0.5000D-02	1.00	-4.85	0.987	-0.149	0.996	-0.645D-01	0.998	361.
0.6000D-02	1.00	-5.83	0.982	-0.178	0.995	-0.772D-01	0.998	360.
0.7000D-02	1.00	-6.80	0.975	-0.207	0.993	-0.900D-01	0.997	360.
0.8000D-02	1.00	-7.77	0.968	-0.236	0.991	-0.103	0.996	360.
0.9000D-02	1.00	-8.74	0.960	-0.264	0.988	-0.115	0.995	359.
0.1000D-01	1.00	-9.71	0.950	-0.292	0.985	-0.128	0.994	359.
0.2000D-01	1.00	-19.5	0.809	-0.548	0.943	-0.246	0.975	352.
0.3000D-01	1.01	-29.3	0.598	-0.737	0.878	-0.349	0.945	341.
0.4000D-01	1.01	-39.2	0.350	-0.844	0.797	-0.429	0.905	327.
0.5000D-01	1.01	-49.3	0.955D-01	-0.865	0.709	-0.486	0.859	310.
0.6000D-01	1.01	-59.5	-0.135	-0.810	0.621	-0.520	0.810	293.
0.7000D-01	1.01	-69.8	-0.322	-0.700	0.538	-0.536	0.759	274.
0.8000D-01	1.01	-80.2	-0.456	-0.555	0.465	-0.538	0.711	257.
0.9000D-01	1.00	-90.6	-0.537	-0.398	0.402	-0.531	0.666	241.
0.100	0.993	-101.	-0.572	-0.243	0.350	-0.519	0.626	226.
0.200	0.890	158.	0.535D-01	0.330	0.829D-01	-0.367	0.376	136.
0.300	0.722	59.0	0.172	-0.101	0.347D-02	-0.276	0.276	99.7
0.400	0.545	-38.9	-0.908D-01	-0.803D-01	-0.373D-01	-0.219	0.222	80.4
0.500	0.380	-135.	-0.304D-01	0.649D-01	-0.653D-01	-0.177	0.189	68.2
0.600	0.240	134.	0.389D-01	0.805D-02	-0.882D-01	-0.140	0.165	59.6
0.700	0.150	41.8	-0.850D-03	-0.209D-01	-0.973D-01	-0.100	0.140	50.5
0.800	0.766D-01	-55.3	-0.873D-02	0.309D-02	-0.980D-01	-0.707D-01	0.121	43.7
0.900	0.312D-01	-109.	-0.310D-03	0.327D-02	-0.958D-01	-0.439D-01	0.105	38.1
1.00	0.516D-02	2.83	-0.445D-03	-0.125D-03	-0.872D-01	-0.200D-01	0.894D-01	32.3

TABLE XXX

RUN ID F-10

CONTD.

DEAD TIME= 12.2 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ-CONTENT NORMALIZED	INPUT FREQ-CONTENT ACTUAL
2.00	0.552D-01	-33.4	0.874D-04	0.109D-02	-0.958D-02	0.174D-01	0.199D-01	7.18
3.00	0.239	-77.9	0.102D-02	0.185D-03	0.139D-03	0.432D-02	0.433D-02	1.56
4.00	0.984	-126.	0.106D-02	-0.339D-03	-0.363D-03	0.108D-02	0.114D-02	0.410
5.00	0.635	170.	0.174D-03	-0.673D-03	-0.455D-03	0.996D-03	0.109D-02	0.395
6.00	0.563	177.	-0.114D-03	-0.378D-03	0.165D-03	0.681D-03	0.700D-03	0.253
7.00	1.45	-152.	-0.526D-03	-0.948D-04	0.352D-03	-0.115D-03	0.370D-03	0.134
8.00	3.61	122.	-0.287D-03	0.313D-03	0.116D-03	0.203D-04	0.118D-03	0.425D-01
9.00	0.667	86.3	-0.843D-04	0.204D-03	0.297D-03	0.146D-03	0.331D-03	0.120
10.0	0.210	62.7	0.590D-04	0.840D-04	0.484D-03	-0.658D-04	0.488D-03	0.176

TABLE XXXI

RUN ID F-11

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 5 LINE APP 1/9/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.00	0.0000D 00	160.	0.0000D 00	160.	0.0000D 00	1.00	160.
0.1000D-02	1.00	-0.726	1.00	-0.252D-01	1.00	-0.125D-01	1.00	160.
0.2000D-02	1.00	-1.45	0.998	-0.504D-01	0.999	-0.251D-01	1.00	160.
0.3000D-02	0.999	-2.18	0.996	-0.755D-01	0.999	-0.376D-01	0.999	160.
0.4000D-02	0.999	-2.90	0.993	-0.100	0.998	-0.501D-01	0.999	160.
0.5000D-02	0.998	-3.63	0.989	-0.125	0.997	-0.626D-01	0.998	160.
0.6000D-02	0.997	-4.35	0.984	-0.150	0.995	-0.750D-01	0.998	160.
0.7000D-02	0.996	-5.08	0.978	-0.174	0.993	-0.873D-01	0.997	160.
0.8000D-02	0.995	-5.80	0.971	-0.198	0.991	-0.997D-01	0.996	160.
0.9000D-02	0.994	-6.53	0.964	-0.222	0.989	-0.112	0.995	160.
0.1000D-01	0.993	-7.25	0.956	-0.246	0.986	-0.124	0.994	160.
0.2000D-01	0.971	-14.4	0.832	-0.454	0.946	-0.240	0.976	159.
0.3000D-01	0.935	-21.4	0.654	-0.599	0.885	-0.341	0.948	157.
0.4000D-01	0.886	-28.2	0.455	-0.668	0.808	-0.422	0.911	152.
0.5000D-01	0.827	-34.5	0.267	-0.666	0.722	-0.481	0.868	146.
0.6000D-01	0.761	-40.3	0.114	-0.613	0.635	-0.518	0.820	139.
0.7000D-01	0.689	-45.4	0.445D-02	-0.531	0.553	-0.536	0.770	131.
0.8000D-01	0.617	-49.5	-0.622D-01	-0.441	0.478	-0.540	0.722	124.
0.9000D-01	0.548	-52.7	-0.954D-01	-0.358	0.414	-0.534	0.676	116.
0.100	0.483	-54.8	-0.106	-0.288	0.360	-0.523	0.635	108.
0.200	0.273	-11.0	0.378D-02	-0.106	0.878D-01	-0.379	0.389	102.
0.300	0.360	-20.5	-0.318D-01	-0.965D-01	0.108D-01	-0.282	0.282	62.4
0.400	0.314	-21.4	-0.361D-01	-0.620D-01	-0.350D-01	-0.226	0.228	45.2
0.500	0.370	-28.6	-0.521D-01	-0.477D-01	-0.620D-01	-0.181	0.191	36.6
0.600	0.303	-34.4	-0.451D-01	-0.222D-01	-0.814D-01	-0.144	0.166	30.6
0.700	0.333	-46.3	-0.467D-01	-0.213D-02	-0.922D-01	-0.106	0.140	26.6
0.800	0.224	-47.8	-0.276D-01	0.446D-02	-0.974D-01	-0.777D-01	0.125	22.5
0.900	0.270	-37.0	-0.281D-01	0.462D-02	-0.937D-01	-0.491D-01	0.106	20.0
1.00	0.266	-57.2	-0.191D-01	0.152D-01	-0.868D-01	-0.293D-01	0.917D-01	17.0

TABLE XXXI

RUN ID F-11

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.898D-01	-119.	0.178D-02	-0.340D-04	-0.931D-02	0.175D-01	0.198D-01	3.18
3.00	0.184	26.2	-0.528D-04	0.626D-03	0.125D-02	0.318D-02	0.341D-02	0.547
4.00	0.601	74.6	-0.393D-03	0.249D-03	0.227D-03	0.739D-03	0.773D-03	0.124
5.00	0.367	51.8	-0.113D-03	-0.231D-05	-0.195D-03	0.238D-03	0.308D-03	0.494D-01
6.00	0.256	-86.8	0.456D-04	0.632D-04	-0.237D-03	0.192D-03	0.305D-03	0.489D-01
7.00	0.219	-47.0	-0.109D-03	0.207D-04	-0.408D-03	-0.300D-03	0.506D-03	0.812D-01
8.00	0.990D-01	92.8	-0.782D-05	-0.396D-04	-0.396D-03	0.981D-04	0.408D-03	0.654D-01
9.00	0.145	38.7	-0.466D-04	0.289D-05	-0.238D-03	0.217D-03	0.322D-03	0.517D-01
10.0	0.240	76.8	-0.392D-04	0.858D-05	-0.249D-05	0.167D-03	0.167D-03	0.268D-01

TABLE XXXI CONTD.

RUN ID F-11

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 5 LINE APP 1/9/69

DEAD TIME= 0.700 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.00	0.0000D 00	160.	0.0000D 00	160.	0.0000D 00	1.00	160.
0.1000D-02	1.00	-0.766	1.00	-0.2590D-01	1.00	-0.1250D-01	1.00	160.
0.2000D-02	1.00	-1.53	0.998	-0.5180D-01	0.999	-0.2510D-01	1.00	160.
0.3000D-02	0.999	-2.30	0.996	-0.7760D-01	0.999	-0.3760D-01	0.999	160.
0.4000D-02	0.999	-3.06	0.992	-0.103	0.998	-0.5010D-01	0.999	160.
0.5000D-02	0.998	-3.83	0.988	-0.129	0.997	-0.6260D-01	0.998	160.
0.6000D-02	0.997	-4.59	0.983	-0.154	0.995	-0.7500D-01	0.998	160.
0.7000D-02	0.996	-5.36	0.977	-0.179	0.993	-0.8730D-01	0.997	160.
0.8000D-02	0.995	-6.12	0.970	-0.204	0.991	-0.9970D-01	0.996	160.
0.9000D-02	0.994	-6.89	0.962	-0.228	0.989	-0.112	0.995	160.
0.1000D-01	0.993	-7.65	0.954	-0.252	0.986	-0.124	0.994	159.
0.2000D-01	0.971	-15.2	0.825	-0.466	0.946	-0.240	0.976	157.
0.3000D-01	0.935	-22.6	0.641	-0.612	0.885	-0.341	0.948	152.
0.4000D-01	0.886	-29.8	0.436	-0.680	0.808	-0.422	0.911	146.
0.5000D-01	0.827	-36.5	0.244	-0.675	0.722	-0.481	0.868	139.
0.6000D-01	0.761	-42.7	0.878D-01	-0.617	0.635	-0.518	0.820	131.
0.7000D-01	0.689	-48.2	-0.216D-01	-0.531	0.553	-0.536	0.770	124.
0.8000D-01	0.617	-52.8	-0.868D-01	-0.437	0.478	-0.540	0.722	116.
0.9000D-01	0.548	-56.3	-0.118	-0.351	0.414	-0.534	0.676	108.
0.100	0.483	-58.9	-0.126	-0.280	0.360	-0.523	0.635	102.
0.200	0.273	-19.0	-0.111D-01	-0.106	0.878D-01	-0.379	0.389	62.4
0.300	0.360	-32.5	-0.513D-01	-0.877D-01	0.108D-01	-0.282	0.282	45.2
0.400	0.314	-37.5	-0.519D-01	-0.496D-01	-0.350D-01	-0.226	0.228	36.6
0.500	0.370	-48.7	-0.653D-01	-0.269D-01	-0.620D-01	-0.181	0.191	30.6
0.600	0.303	-58.5	-0.502D-01	-0.186D-02	-0.814D-01	-0.144	0.166	26.6
0.700	0.333	-74.3	-0.422D-01	0.201D-01	-0.922D-01	-0.106	0.140	22.5
0.800	0.224	-79.9	-0.210D-01	0.184D-01	-0.974D-01	-0.777D-01	0.125	20.0
0.900	0.270	-73.0	-0.200D-01	0.203D-01	-0.937D-01	-0.491D-01	0.106	17.0
1.00	0.266	-97.3	-0.480D-02	0.239D-01	-0.868D-01	-0.293D-01	0.917D-01	14.7

TABLE XXXI

RUN ID F-11

CONTD.

DEAD TIME= 0.700   PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.898D-01	161.	0.269D-03	-0.176D-02	-0.931D-02	0.175D-01	0.198D-01	3.18
3.00	0.184	-94.1	0.567D-03	-0.271D-03	0.125D-02	0.318D-02	0.341D-02	0.547
4.00	0.601	-85.8	0.454D-03	-0.103D-03	0.227D-03	0.739D-03	0.773D-03	0.124
5.00	0.367	-149.	0.107D-03	-0.375D-04	-0.195D-03	0.238D-03	0.308D-03	0.494D-01
6.00	0.256	32.6	-0.774D-04	0.874D-05	-0.237D-03	0.192D-03	0.305D-03	0.489D-01
7.00	0.219	32.2	-0.406D-04	-0.103D-03	-0.408D-03	-0.300D-03	0.506D-03	0.812D-01
8.00	0.990D-01	132.	0.189D-04	-0.356D-04	-0.396D-03	0.981D-04	0.408D-03	0.654D-01
9.00	0.145	37.8	-0.465D-04	0.367D-05	-0.238D-03	0.217D-03	0.322D-03	0.517D-01
10.0	0.240	35.7	-0.239D-04	0.322D-04	-0.249D-05	0.167D-03	0.167D-03	0.268D-01

ORTRAN ** STOP

TABLE XXXII

RUN ID F-12

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 4 LINE APP 1/9/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.897	0.0000D 00	336.	0.0000D 00	374.	0.0000D 00	1.00	374.
0.1000D-02	1.00	-0.674	1.00	-0.2420D-01	1.00	-0.1240D-01	1.00	374.
0.2000D-02	1.00	-1.35	0.998	-0.4830D-01	0.999	-0.2480D-01	1.00	374.
0.3000D-02	0.999	-2.02	0.996	-0.7240D-01	0.999	-0.3720D-01	0.999	374.
0.4000D-02	0.999	-2.70	0.994	-0.9630D-01	0.998	-0.4950D-01	0.999	374.
0.5000D-02	0.999	-3.37	0.990	-0.120	0.997	-0.6190D-01	0.999	374.
0.6000D-02	0.998	-4.04	0.985	-0.144	0.995	-0.7410D-01	0.998	374.
0.7000D-02	0.997	-4.72	0.980	-0.167	0.993	-0.8640D-01	0.997	373.
0.8000D-02	0.996	-5.39	0.974	-0.191	0.991	-0.9860D-01	0.996	373.
0.9000D-02	0.995	-6.06	0.968	-0.214	0.989	-0.111	0.995	373.
0.1000D-01	0.994	-6.74	0.960	-0.236	0.987	-0.123	0.994	372.
0.2000D-01	0.977	-13.5	0.847	-0.442	0.948	-0.238	0.977	366.
0.3000D-01	0.949	-20.1	0.681	-0.592	0.888	-0.339	0.950	356.
0.4000D-01	0.910	-26.8	0.488	-0.674	0.812	-0.420	0.915	342.
0.5000D-01	0.860	-33.3	0.296	-0.689	0.727	-0.481	0.872	326.
0.6000D-01	0.800	-39.6	0.130	-0.647	0.640	-0.520	0.825	309.
0.7000D-01	0.732	-45.5	0.365D-02	-0.567	0.557	-0.540	0.775	290.
0.8000D-01	0.656	-50.9	-0.784D-01	-0.470	0.481	-0.544	0.726	272.
0.9000D-01	0.576	-55.5	-0.120	-0.373	0.415	-0.538	0.679	254.
0.100	0.495	-58.8	-0.130	-0.287	0.360	-0.525	0.637	238.
0.200	0.304	-4.78	0.172D-01	-0.118	0.884D-01	-0.380	0.391	146.
0.300	0.412	-21.1	-0.395D-01	-0.114	0.100D-01	-0.292	0.292	109.
0.400	0.352	-33.3	-0.549D-01	-0.627D-01	-0.324D-01	-0.234	0.236	88.5
0.500	0.393	-31.7	-0.617D-01	-0.471D-01	-0.704D-01	-0.184	0.197	73.9
0.600	0.338	-50.6	-0.563D-01	-0.735D-02	-0.889D-01	-0.142	0.168	62.8
0.700	0.332	-49.5	-0.484D-01	0.236D-02	-0.100	-0.106	0.146	54.7
0.800	0.301	-68.8	-0.314D-01	0.206D-01	-0.101	-0.725D-01	0.125	46.6
0.900	0.276	-54.4	-0.253D-01	0.143D-01	-0.954D-01	-0.444D-01	0.105	39.4
1.00	0.284	-70.6	-0.149D-01	0.216D-01	-0.891D-01	-0.240D-01	0.923D-01	34.5

TABLE XXXII

RUN ID F-12

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.114	-146.	0.181D-02	-0.105D-02	-0.787D-02	0.165D-01	0.183D-01	6.85
3.00	0.378	110.	-0.119D-02	0.422D-03	0.211D-02	0.258D-02	0.334D-02	1.25
4.00	2.09	-57.2	-0.267D-03	0.121D-02	-0.556D-03	0.207D-03	0.593D-03	0.222
5.00	1.06	-73.1	0.783D-03	0.400D-04	0.179D-03	0.720D-03	0.742D-03	0.278
6.00	2.73	-138.	-0.678D-03	-0.139D-03	0.219D-03	-0.127D-03	0.253D-03	0.949D-01
7.00	0.885	-146.	-0.203D-04	0.681D-03	-0.408D-03	-0.653D-03	0.770D-03	0.288
8.00	0.852	-171.	0.279D-03	-0.102D-03	-0.306D-03	0.167D-03	0.349D-03	0.131
9.00	0.542	80.6	-0.167D-03	-0.857D-04	-0.206D-03	0.278D-03	0.347D-03	0.130
10.0	0.799	-107.	-0.102D-03	0.123D-04	0.234D-04	-0.127D-03	0.129D-03	0.482D-01

TABLE XXXII CONTD.

RUN ID F-12

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 4 LINE APP 1/9/69

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.897	0.0000D 00	336.	0.0000D 00	374.	0.0000D 00	1.00	374.
0.1000D-02	1.00	-0.708	1.00	-0.248D-01	1.00	-0.124D-01	1.00	374.
0.2000D-02	1.00	-1.42	0.998	-0.495D-01	0.999	-0.248D-01	1.00	374.
0.3000D-02	0.999	-2.12	0.996	-0.741D-01	0.999	-0.372D-01	0.999	374.
0.4000D-02	0.999	-2.83	0.993	-0.987D-01	0.998	-0.495D-01	0.999	374.
0.5000D-02	0.999	-3.54	0.990	-0.123	0.997	-0.619D-01	0.999	374.
0.6000D-02	0.998	-4.25	0.985	-0.147	0.995	-0.741D-01	0.998	374.
0.7000D-02	0.997	-4.96	0.980	-0.171	0.993	-0.864D-01	0.997	373.
0.8000D-02	0.996	-5.67	0.973	-0.195	0.991	-0.986D-01	0.996	373.
0.9000D-02	0.995	-6.37	0.966	-0.219	0.989	-0.111	0.995	373.
0.1000D-01	0.994	-7.08	0.959	-0.242	0.987	-0.123	0.994	372.
0.2000D-01	0.977	-14.1	0.842	-0.452	0.948	-0.238	0.977	366.
0.3000D-01	0.949	-21.2	0.670	-0.604	0.888	-0.339	0.950	356.
0.4000D-01	0.910	-28.1	0.471	-0.686	0.812	-0.420	0.915	342.
0.5000D-01	0.860	-35.0	0.276	-0.698	0.727	-0.481	0.872	326.
0.6000D-01	0.800	-41.6	0.107	-0.651	0.640	-0.520	0.825	309.
0.7000D-01	0.732	-47.9	-0.202D-01	-0.567	0.557	-0.540	0.775	290.
0.8000D-01	0.656	-53.7	-0.101	-0.466	0.481	-0.544	0.726	272.
0.9000D-01	0.576	-58.6	-0.140	-0.366	0.415	-0.538	0.679	254.
0.100	0.495	-62.2	-0.147	-0.279	0.360	-0.525	0.637	238.
0.200	0.304	-11.7	0.297D-02	-0.119	0.884D-01	-0.380	0.391	146.
0.300	0.412	-31.4	-0.593D-01	-0.105	0.100D-01	-0.292	0.292	109.
0.400	0.352	-47.1	-0.682D-01	-0.478D-01	-0.324D-01	-0.234	0.236	88.5
0.500	0.393	-48.9	-0.729D-01	-0.268D-01	-0.704D-01	-0.184	0.197	73.9
0.600	0.338	-71.2	-0.553D-01	0.130D-01	-0.889D-01	-0.142	0.168	62.8
0.700	0.332	-73.6	-0.432D-01	0.219D-01	-0.100	-0.106	0.146	54.7
0.800	0.301	-96.3	-0.183D-01	0.327D-01	-0.101	-0.725D-01	0.125	46.6
0.900	0.276	-85.3	-0.143D-01	0.252D-01	-0.954D-01	-0.444D-01	0.105	39.4
1.00	0.284	-105.	-0.773D-04	0.263D-01	-0.891D-01	-0.240D-01	0.923D-01	34.5

TABLE XXXII

RUN ID F-12

CONTD.

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.114	146.	-0.323D-03	-0.207D-02	-0.787D-02	0.165D-01	0.183D-01	6.85
3.00	0.378	6.57	0.682D-03	0.106D-02	0.211D-02	0.258D-02	0.334D-02	1.25
4.00	2.09	165.	0.102D-02	-0.714D-03	-0.556D-03	0.207D-03	0.593D-03	0.222
5.00	1.06	115.	-0.770D-03	-0.150D-03	0.179D-03	0.720D-03	0.742D-03	0.278
6.00	2.73	15.5	0.670D-03	-0.175D-03	0.219D-03	-0.127D-03	0.253D-03	0.949D-01
7.00	0.885	-27.0	-0.584D-03	-0.352D-03	-0.408D-03	-0.653D-03	0.770D-03	0.288
8.00	0.852	-86.4	0.126D-03	0.269D-03	-0.306D-03	0.167D-03	0.349D-03	0.131
9.00	0.542	131.	-0.399D-04	-0.184D-03	-0.206D-03	0.278D-03	0.347D-03	0.130
10.0	0.799	-91.1	-0.101D-03	-0.167D-04	0.234D-04	-0.127D-03	0.129D-03	0.482D-01

TABLE XXXIII

RUN ID F-13

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 4 LINE APP 1/9/69

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.02	0.000D 00	381.	0.000D 00	373.	0.000D 00	1.00	373.
0.100D-02	1.00	-0.562	1.00	-0.222D-01	1.00	-0.124D-01	1.00	373.
0.200D-02	1.00	-1.12	0.999	-0.444D-01	0.999	-0.248D-01	1.00	373.
0.300D-02	1.00	-1.68	0.997	-0.665D-01	0.999	-0.372D-01	0.999	373.
0.400D-02	0.999	-2.25	0.994	-0.885D-01	0.998	-0.495D-01	0.999	373.
0.500D-02	0.999	-2.81	0.991	-0.110	0.997	-0.618D-01	0.999	373.
0.600D-02	0.998	-3.37	0.987	-0.132	0.995	-0.741D-01	0.998	372.
0.700D-02	0.997	-3.93	0.983	-0.154	0.993	-0.863D-01	0.997	372.
0.800D-02	0.997	-4.49	0.977	-0.175	0.991	-0.985D-01	0.996	372.
0.900D-02	0.996	-5.05	0.971	-0.196	0.989	-0.111	0.995	371.
0.100D-01	0.995	-5.61	0.965	-0.217	0.987	-0.123	0.994	371.
0.200D-01	0.979	-11.2	0.865	-0.408	0.948	-0.238	0.977	365.
0.300D-01	0.953	-16.7	0.718	-0.552	0.888	-0.338	0.950	354.
0.400D-01	0.917	-22.1	0.545	-0.637	0.812	-0.419	0.914	341.
0.500D-01	0.872	-27.4	0.371	-0.663	0.728	-0.479	0.871	325.
0.600D-01	0.817	-32.3	0.216	-0.637	0.641	-0.518	0.824	308.
0.700D-01	0.754	-36.8	0.938D-01	-0.577	0.558	-0.538	0.775	289.
0.800D-01	0.686	-40.7	0.877D-02	-0.499	0.483	-0.543	0.726	271.
0.900D-01	0.616	-43.5	-0.414D-01	-0.417	0.417	-0.537	0.680	254.
0.100	0.547	-45.1	-0.639D-01	-0.343	0.362	-0.525	0.638	238.
0.200	0.347	-5.81	0.184D-01	-0.133	0.916D-01	-0.377	0.388	145.
0.300	0.539	-13.3	-0.292D-01	-0.150	0.112D-01	-0.283	0.284	106.
0.400	0.434	-32.3	-0.625D-01	-0.781D-01	-0.256D-01	-0.229	0.231	86.1
0.500	0.406	-24.1	-0.543D-01	-0.584D-01	-0.635D-01	-0.186	0.197	73.4
0.600	0.459	-38.4	-0.704D-01	-0.283D-01	-0.819D-01	-0.144	0.165	61.7
0.700	0.317	-52.1	-0.449D-01	0.147D-02	-0.906D-01	-0.109	0.142	52.9
0.800	0.321	-37.3	-0.384D-01	-0.226D-02	-0.911D-01	-0.782D-01	0.120	44.8
0.900	0.321	-48.4	-0.327D-01	0.108D-01	-0.927D-01	-0.535D-01	0.107	39.9
1.00	0.238	-56.7	-0.182D-01	0.126D-01	-0.861D-01	-0.347D-01	0.928D-01	34.6

TABLE XXXIII

RUN ID F-13

CONTD.

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.399D-01	41.7	-0.761D-03	0.146D-03	-0.118D-01	0.154D-01	0.194D-01	7.25
3.00	0.125	-142.	0.268D-03	-0.437D-03	0.467D-03	0.409D-02	0.411D-02	1.53
4.00	0.771	50.2	-0.467D-03	0.126D-03	-0.262D-03	0.569D-03	0.626D-03	0.234
5.00	2.87	131.	-0.150D-03	-0.149D-04	0.301D-04	0.430D-04	0.525D-04	0.196D-01
6.00	2.34	-140.	-0.405D-03	0.569D-04	0.117D-03	-0.130D-03	0.175D-03	0.653D-01
7.00	0.774D-01	111.	0.714D-04	-0.362D-04	-0.763D-03	-0.699D-03	0.103D-02	0.386
8.00	0.441	11.5	-0.223D-03	0.681D-05	-0.493D-03	0.116D-03	0.506D-03	0.189
9.00	0.163	42.4	-0.844D-04	0.186D-04	-0.305D-03	0.433D-03	0.530D-03	0.198
10.0	0.491	3.00	-0.987D-04	0.351D-05	-0.201D-03	0.177D-04	0.201D-03	0.751D-01

TABLE XXXIII CONTD.

RUN ID F-13

COMMENTS F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 4 LINE APP 1/9/69

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.02	0.000D 00	381.	0.000D 00	373.	0.000D 00	1.00	373.
0.100D-02	1.00	-0.596	1.00	-0.228D-01	1.00	-0.124D-01	1.00	373.
0.200D-02	1.00	-1.19	0.999	-0.456D-01	0.999	-0.248D-01	1.00	373.
0.300D-02	1.00	-1.79	0.997	-0.683D-01	0.999	-0.372D-01	1.00	373.
0.400D-02	0.999	-2.38	0.994	-0.909D-01	0.998	-0.495D-01	0.999	373.
0.500D-02	0.999	-2.98	0.991	-0.113	0.997	-0.618D-01	0.999	373.
0.600D-02	0.998	-3.58	0.987	-0.136	0.995	-0.741D-01	0.998	372.
0.700D-02	0.997	-4.17	0.982	-0.158	0.993	-0.863D-01	0.997	372.
0.800D-02	0.997	-4.77	0.977	-0.180	0.991	-0.985D-01	0.996	372.
0.900D-02	0.996	-5.36	0.970	-0.202	0.989	-0.111	0.995	371.
0.100D-01	0.995	-5.96	0.964	-0.223	0.987	-0.123	0.994	371.
0.200D-01	0.979	-11.9	0.860	-0.419	0.948	-0.238	0.977	365.
0.300D-01	0.953	-17.8	0.708	-0.565	0.888	-0.330	0.950	354.
0.400D-01	0.917	-23.5	0.530	-0.650	0.812	-0.419	0.914	341.
0.500D-01	0.872	-29.1	0.351	-0.673	0.728	-0.479	0.871	325.
0.600D-01	0.817	-34.4	0.193	-0.645	0.641	-0.518	0.824	308.
0.700D-01	0.754	-39.2	0.695D-01	-0.580	0.558	-0.538	0.775	289.
0.800D-01	0.686	-43.4	-0.152D-01	-0.498	0.483	-0.543	0.726	271.
0.900D-01	0.616	-46.6	-0.638D-01	-0.414	0.417	-0.537	0.680	254.
0.100	0.547	-48.6	-0.844D-01	-0.339	0.362	-0.525	0.638	238.
0.200	0.347	-12.7	0.227D-02	-0.135	0.916D-01	-0.377	0.388	145.
0.300	0.539	-23.6	-0.555D-01	-0.142	0.112D-01	-0.283	0.284	106.
0.400	0.434	-46.1	-0.793D-01	-0.610D-01	-0.256D-01	-0.229	0.231	86.1
0.500	0.406	-41.2	-0.691D-01	-0.398D-01	-0.635D-01	-0.186	0.197	73.4
0.600	0.459	-59.1	-0.759D-01	-0.166D-02	-0.819D-01	-0.144	0.165	61.7
0.700	0.317	-76.2	-0.404D-01	0.196D-01	-0.906D-01	-0.109	0.142	52.9
0.800	0.321	-64.8	-0.351D-01	0.157D-01	-0.911D-01	-0.782D-01	0.120	44.8
0.900	0.321	-79.3	-0.224D-01	0.261D-01	-0.927D-01	-0.535D-01	0.107	39.9
1.00	0.238	-91.1	-0.788D-02	0.207D-01	-0.861D-01	-0.347D-01	0.928D-01	34.6

TABLE XXXIII

RUN ID F-13

CONTD.

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.399D-01	-27.1	-0.140D-03	0.762D-03	-0.118D-01	0.154D-01	0.194D-01	7.25
3.00	0.125	115.	-0.486D-03	-0.162D-03	0.467D-03	0.409D-02	0.411D-02	1.53
4.00	0.771	-87.4	0.429D-03	0.222D-03	-0.262D-03	0.569D-03	0.626D-03	0.234
5.00	2.87	-41.2	0.146D-03	0.359D-04	0.301D-04	0.430D-04	0.525D-04	0.196D-01
6.00	2.34	13.7	0.338D-03	-0.230D-03	0.117D-03	-0.130D-03	0.175D-03	0.653D-01
7.00	0.774D-01	-130.	-0.345D-05	0.800D-04	-0.763D-03	-0.699D-03	0.103D-02	0.386
8.00	0.441	96.5	-0.263D-04	-0.222D-03	-0.493D-03	0.116D-03	0.506D-03	0.189
9.00	0.163	93.0	-0.679D-04	-0.534D-04	-0.305D-03	0.433D-03	0.530D-03	0.198
10.0	0.491	19.2	-0.958D-04	-0.242D-04	-0.201D-03	0.177D-04	0.201D-03	0.751D-01

TABLE XXXIV

RUN ID F-14

COMMENTS F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 5 LINE APP 1/22/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.14	0.000D 00	153.	0.000D 00	135.	0.000D 00	1.00	135.
0.1000D-02	1.00	-0.560	1.00	-0.218D-01	1.00	-0.121D-01	1.00	135.
0.2000D-02	1.00	-1.12	0.999	-0.436D-01	0.999	-0.241D-01	1.00	135.
0.3000D-02	0.999	-1.68	0.997	-0.654D-01	0.999	-0.361D-01	1.00	135.
0.4000D-02	0.999	-2.24	0.994	-0.870D-01	0.998	-0.482D-01	0.999	135.
0.5000D-02	0.998	-2.80	0.991	-0.109	0.997	-0.601D-01	0.999	135.
0.6000D-02	0.997	-3.36	0.987	-0.130	0.995	-0.721D-01	0.998	134.
0.7000D-02	0.996	-3.91	0.982	-0.151	0.994	-0.840D-01	0.997	134.
0.8000D-02	0.995	-4.47	0.976	-0.172	0.992	-0.958D-01	0.997	134.
0.9000D-02	0.994	-5.02	0.970	-0.193	0.990	-0.108	0.996	134.
0.1000D-01	0.992	-5.58	0.963	-0.213	0.987	-0.119	0.995	134.
0.2000D-01	0.969	-11.0	0.862	-0.396	0.951	-0.232	0.979	132.
0.3000D-01	0.932	-16.0	0.716	-0.526	0.894	-0.331	0.953	128.
0.4000D-01	0.884	-20.5	0.553	-0.596	0.821	-0.413	0.919	124.
0.5000D-01	0.830	-24.2	0.398	-0.611	0.740	-0.475	0.879	118.
0.6000D-01	0.773	-27.0	0.270	-0.585	0.654	-0.516	0.834	112.
0.7000D-01	0.720	-28.8	0.173	-0.538	0.571	-0.539	0.786	106.
0.8000D-01	0.673	-29.7	0.107	-0.484	0.494	-0.547	0.737	99.3
0.9000D-01	0.635	-30.0	0.616D-01	-0.434	0.426	-0.543	0.690	92.9
0.100	0.605	-30.2	0.307D-01	-0.389	0.367	-0.531	0.645	87.0
0.200	0.451	-22.8	-0.214D-01	-0.175	0.107	-0.375	0.390	52.6
0.300	0.418	-20.0	-0.309D-01	-0.116	0.257D-01	-0.286	0.288	38.7
0.400	0.458	-21.8	-0.474D-01	-0.954D-01	-0.188D-01	-0.232	0.233	31.3
0.500	0.421	-31.5	-0.599D-01	-0.560D-01	-0.518D-01	-0.188	0.195	26.3
0.600	0.368	-29.7	-0.503D-01	-0.359D-01	-0.704D-01	-0.153	0.168	22.6
0.700	0.340	-40.3	-0.485D-01	-0.134D-01	-0.833D-01	-0.122	0.148	19.9
0.800	0.269	-31.8	-0.334D-01	-0.852D-02	-0.889D-01	-0.923D-01	0.128	17.3
0.900	0.200	-35.3	-0.228D-01	-0.526D-03	-0.916D-01	-0.681D-01	0.114	15.4
1.00	0.228	-19.4	-0.223D-01	-0.258D-02	-0.887D-01	-0.432D-01	0.987D-01	13.3

TABLE XXXIV

RUN ID F-14

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.213	24.4	-0.436D-02	0.188D-02	-0.150D-01	0.165D-01	0.223D-01	3.00
3.00	0.447	11.9	-0.576D-03	0.200D-02	-0.339D-03	0.465D-02	0.466D-02	0.628
4.00	0.684	-65.0	0.649D-03	0.256D-03	0.620D-04	0.102D-02	0.102D-02	0.137
5.00	4.12	66.1	-0.453D-03	-0.471D-03	-0.149D-03	0.544D-04	0.159D-03	0.214D-01
6.00	3.95	-124.	-0.399D-03	0.289D-03	-0.359D-05	-0.125D-03	0.125D-03	0.168D-01
7.00	0.148	154.	0.102D-03	0.260D-04	-0.540D-03	-0.464D-03	0.712D-03	0.959D-01
8.00	0.345	80.3	-0.409D-04	-0.186D-03	-0.552D-03	0.258D-04	0.552D-03	0.744D-01
9.00	0.430	34.6	-0.164D-03	0.391D-05	-0.309D-03	0.224D-03	0.382D-03	0.515D-01
10.0	0.461	108.	-0.263D-04	-0.693D-04	-0.126D-03	0.101D-03	0.161D-03	0.217D-01

TABLE XXXIV CONTD.

RUN ID F-14

COMMENTS F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 5 LINE APP 1/22/69

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.000D 00	1.14	0.000D 00	153.	0.000D 00	135.	0.000D 00	1.00	135.
0.100D-02	1.00	-0.586	1.00	-0.223D-01	1.00	-0.121D-01	1.00	135.
0.200D-02	1.00	-1.17	0.998	-0.445D-01	0.999	-0.241D-01	1.00	135.
0.300D-02	0.999	-1.76	0.997	-0.667D-01	0.999	-0.361D-01	1.00	135.
0.400D-02	0.999	-2.34	0.994	-0.888D-01	0.998	-0.482D-01	0.999	135.
0.500D-02	0.998	-2.93	0.990	-0.111	0.997	-0.601D-01	0.999	135.
0.600D-02	0.997	-3.51	0.986	-0.133	0.995	-0.721D-01	0.998	134.
0.700D-02	0.996	-4.09	0.981	-0.154	0.994	-0.840D-01	0.997	134.
0.800D-02	0.995	-4.68	0.976	-0.175	0.992	-0.958D-01	0.997	134.
0.900D-02	0.994	-5.26	0.969	-0.197	0.990	-0.108	0.996	134.
0.100D-01	0.992	-5.83	0.962	-0.217	0.987	-0.119	0.995	134.
0.200D-01	0.969	-11.5	0.858	-0.403	0.951	-0.232	0.979	132.
0.300D-01	0.932	-16.8	0.708	-0.536	0.894	-0.331	0.953	128.
0.400D-01	0.884	-21.5	0.542	-0.606	0.821	-0.413	0.919	124.
0.500D-01	0.830	-25.5	0.385	-0.619	0.740	-0.475	0.879	118.
0.600D-01	0.773	-28.5	0.254	-0.592	0.654	-0.516	0.834	112.
0.700D-01	0.720	-30.6	0.156	-0.543	0.571	-0.539	0.786	106.
0.800D-01	0.673	-31.7	0.891D-01	-0.488	0.494	-0.547	0.737	99.3
0.900D-01	0.635	-32.4	0.440D-01	-0.436	0.426	-0.543	0.690	92.9
0.100	0.605	-32.8	0.131D-01	-0.390	0.367	-0.531	0.645	87.0
0.200	0.451	-28.0	-0.370D-01	-0.172	0.107	-0.375	0.390	52.6
0.300	0.418	-27.8	-0.462D-01	-0.111	0.257D-01	-0.286	0.288	38.7
0.400	0.458	-32.1	-0.637D-01	-0.854D-01	-0.188D-01	-0.232	0.233	31.3
0.500	0.421	-44.4	-0.709D-01	-0.412D-01	-0.518D-01	-0.188	0.195	26.3
0.600	0.368	-45.2	-0.580D-01	-0.212D-01	-0.704D-01	-0.153	0.168	22.6
0.700	0.340	-58.3	-0.503D-01	0.229D-02	-0.833D-01	-0.122	0.148	19.9
0.800	0.269	-52.4	-0.343D-01	0.380D-02	-0.889D-01	-0.923D-01	0.128	17.3
0.900	0.200	-58.5	-0.212D-01	0.852D-02	-0.916D-01	-0.681D-01	0.114	15.4
1.00	0.228	-45.1	-0.212D-01	0.740D-02	-0.887D-01	-0.432D-01	0.987D-01	13.3

TABLE XXXIV

RUN ID F-14

CONTD.

DEAD TIME= 0.450 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.213	-27.2	-0.124D-02	0.458D-02	-0.150D-01	0.165D-01	0.223D-01	3.00
3.00	0.447	-65.5	0.183D-02	0.100D-02	-0.339D-03	0.465D-02	0.466D-02	0.628
4.00	0.684	-168.	0.102D-03	-0.690D-03	0.620D-04	0.102D-02	0.102D-02	0.137
5.00	4.12	-62.8	-0.818D-04	0.648D-03	-0.149D-03	0.544D-04	0.159D-03	0.214D-01
6.00	3.95	81.0	0.484D-03	-0.912D-04	-0.359D-05	-0.125D-03	0.125D-03	0.168D-01
7.00	0.148	-26.9	-0.102D-03	-0.251D-04	-0.540D-03	-0.464D-03	0.712D-03	0.959D-01
8.00	0.345	-126.	0.119D-03	0.149D-03	-0.552D-03	0.258D-04	0.552D-03	0.744D-01
9.00	0.430	163.	0.978D-04	-0.132D-03	-0.309D-03	0.224D-03	0.382D-03	0.515D-01
10.0	0.461	-150.	0.733D-04	-0.111D-04	-0.126D-03	0.101D-03	0.161D-03	0.217D-01

TABLE XXXV

RUN ID F-16

COMMENTS F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.999	0.0000D 00	317.	0.0000D 00	318.	0.0000D 00	1.00	318.
0.1000D-02	0.965	17.1	1.00	-0.212D-01	0.983	-0.326	1.04	329.
0.2000D-02	1.00	7.94	0.999	-0.425D-01	0.983	-0.180	0.999	317.
0.3000D-02	1.01	4.38	0.997	-0.636D-01	0.982	-0.139	0.992	315.
0.4000D-02	1.01	2.31	0.995	-0.847D-01	0.981	-0.124	0.989	314.
0.5000D-02	1.01	0.839	0.992	-0.106	0.980	-0.119	0.988	314.
0.6000D-02	1.01	-0.330	0.988	-0.127	0.979	-0.120	0.987	313.
0.7000D-02	1.01	-1.32	0.984	-0.147	0.978	-0.123	0.986	313.
0.8000D-02	1.01	-2.21	0.979	-0.168	0.976	-0.129	0.985	313.
0.9000D-02	1.01	-3.02	0.973	-0.188	0.974	-0.135	0.984	313.
0.1000D-01	1.01	-3.78	0.967	-0.208	0.972	-0.143	0.983	312.
0.2000D-01	0.989	-10.2	0.875	-0.392	0.941	-0.233	0.969	308.
0.3000D-01	0.959	-15.8	0.738	-0.531	0.891	-0.324	0.948	301.
0.4000D-01	0.919	-20.9	0.578	-0.616	0.826	-0.403	0.919	292.
0.5000D-01	0.872	-25.4	0.418	-0.648	0.751	-0.466	0.884	281.
0.6000D-01	0.820	-29.3	0.275	-0.635	0.671	-0.512	0.844	268.
0.7000D-01	0.767	-32.4	0.160	-0.592	0.590	-0.540	0.800	254.
0.8000D-01	0.716	-34.7	0.762D-01	-0.535	0.513	-0.554	0.754	240.
0.9000D-01	0.670	-36.2	0.198D-01	-0.474	0.442	-0.554	0.709	225.
0.100	0.632	-37.1	-0.161D-01	-0.419	0.379	-0.545	0.664	211.
0.200	0.411	-38.6	-0.652D-01	-0.152	0.107	-0.388	0.402	128.
0.300	0.386	-28.5	-0.457D-01	-0.104	0.246D-01	-0.293	0.294	93.5
0.400	0.393	-39.1	-0.661D-01	-0.656D-01	-0.253D-01	-0.236	0.237	75.3
0.500	0.381	-40.8	-0.658D-01	-0.403D-01	-0.617D-01	-0.193	0.203	64.3
0.600	0.326	-56.7	-0.556D-01	-0.662D-02	-0.765D-01	-0.153	0.172	54.5
0.700	0.291	-61.8	-0.428D-01	0.653D-02	-0.893D-01	-0.119	0.149	47.3
0.800	0.227	-59.7	-0.291D-01	0.909D-02	-0.994D-01	-0.904D-01	0.134	42.7
0.900	0.238	-65.7	-0.222D-01	0.150D-01	-0.959D-01	-0.592D-01	0.113	35.8
1.00	0.198	-78.0	-0.108D-01	0.160D-01	-0.902D-01	-0.365D-01	0.973D-01	30.9

TABLE XXXV

RUN ID F-16

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.223	-10.3	-0.199D-02	0.459D-02	-0.125D-01	0.187D-01	0.225D-01	7.14
3.00	0.182	-102.	0.645D-03	-0.512D-03	0.203D-02	0.405D-02	0.453D-02	1.44
4.00	0.634	99.2	-0.435D-03	0.275D-04	0.153D-03	0.670D-03	0.687D-03	0.218
5.00	0.297	32.2	-0.206D-03	0.556D-04	-0.486D-03	0.528D-03	0.718D-03	0.228
6.00	0.381	-70.5	-0.452D-04	-0.112D-04	-0.119D-04	-0.122D-03	0.122D-03	0.388D-01
7.00	0.121	-151.	0.297D-04	0.715D-04	-0.499D-03	-0.397D-03	0.638D-03	0.203
8.00	0.107	16.5	-0.351D-04	0.239D-04	-0.252D-03	0.309D-03	0.399D-03	0.127
9.00	0.424	-28.8	-0.468D-04	0.620D-04	-0.167D-03	0.751D-04	0.183D-03	0.583D-01
10.0	0.894	46.8	0.784D-04	-0.569D-04	0.136D-04	-0.108D-03	0.108D-03	0.344D-01

TABLE XXXV CONTD.

RUN ID F-16

COMMENTS F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	0.999	0.0000D 00	317.	0.0000D 00	318.	0.0000D 00	1.00	318.
0.1000D-02	0.965	17.1	1.00	-0.2180D-01	0.983	-0.326	1.04	329.
0.2000D-02	1.00	7.87	0.999	-0.4370D-01	0.983	-0.180	0.999	317.
0.3000D-02	1.01	4.28	0.997	-0.6540D-01	0.982	-0.139	0.992	315.
0.4000D-02	1.01	2.17	0.994	-0.8710D-01	0.981	-0.124	0.989	314.
0.5000D-02	1.01	0.667	0.991	-0.109	0.980	-0.119	0.988	314.
0.6000D-02	1.01	-0.536	0.988	-0.130	0.979	-0.120	0.987	313.
0.7000D-02	1.01	-1.56	0.983	-0.151	0.978	-0.123	0.986	313.
0.8000D-02	1.01	-2.48	0.978	-0.172	0.976	-0.129	0.985	313.
0.9000D-02	1.01	-3.33	0.972	-0.193	0.974	-0.135	0.984	313.
0.1000D-01	1.01	-4.13	0.966	-0.214	0.972	-0.143	0.983	312.
0.2000D-01	0.989	-10.9	0.870	-0.402	0.941	-0.233	0.969	308.
0.3000D-01	0.959	-16.8	0.728	-0.544	0.891	-0.324	0.948	301.
0.4000D-01	0.919	-22.2	0.563	-0.630	0.826	-0.403	0.919	292.
0.5000D-01	0.872	-27.1	0.398	-0.660	0.751	-0.466	0.884	281.
0.6000D-01	0.820	-31.4	0.252	-0.645	0.671	-0.512	0.844	268.
0.7000D-01	0.767	-34.8	0.135	-0.599	0.590	-0.540	0.800	254.
0.8000D-01	0.716	-37.4	0.504D-01	-0.538	0.513	-0.554	0.754	240.
0.9000D-01	0.670	-39.3	-0.584D-02	-0.475	0.442	-0.554	0.709	225.
0.100	0.632	-40.5	-0.412D-01	-0.417	0.379	-0.545	0.664	211.
0.200	0.411	-45.5	-0.830D-01	-0.143	0.107	-0.388	0.402	128.
0.300	0.386	-38.8	-0.636D-01	-0.941D-01	0.246D-01	-0.293	0.294	93.5
0.400	0.393	-52.8	-0.798D-01	-0.480D-01	-0.253D-01	-0.236	0.237	75.3
0.500	0.381	-58.0	-0.748D-01	-0.191D-01	-0.617D-01	-0.193	0.203	64.3
0.600	0.326	-77.3	-0.543D-01	0.134D-01	-0.765D-01	-0.153	0.172	54.5
0.700	0.291	-85.9	-0.364D-01	0.234D-01	-0.893D-01	-0.119	0.149	47.3
0.800	0.227	-87.2	-0.216D-01	0.215D-01	-0.994D-01	-0.904D-01	0.134	42.7
0.900	0.238	-96.6	-0.114D-01	0.243D-01	-0.959D-01	-0.592D-01	0.113	35.8
1.00	0.198	-112.	0.113D-03	0.193D-01	-0.902D-01	-0.365D-01	0.973D-01	30.9

TABLE XXXV

RUN ID F-16

CONTD.

DEAD TIME= 0.600 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.223	-79.1	0.356D-02	0.352D-02	-0.125D-01	0.187D-01	0.225D-01	7.14
3.00	0.182	155.	-0.645D-03	-0.512D-03	0.203D-02	0.405D-02	0.453D-02	1.44
4.00	0.634	-38.3	0.339D-03	0.273D-03	0.153D-03	0.670D-03	0.687D-03	0.218
5.00	0.297	-140.	0.212D-03	-0.261D-04	-0.486D-03	0.528D-03	0.718D-03	0.228
6.00	0.381	83.2	0.455D-04	-0.997D-05	-0.119D-04	-0.122D-03	0.122D-03	0.388D-01
7.00	0.121	-31.7	-0.769D-04	-0.913D-05	-0.499D-03	-0.397D-03	0.638D-03	0.203
8.00	0.107	102.	-0.269D-04	-0.329D-04	-0.252D-03	0.309D-03	0.399D-03	0.127
9.00	0.424	21.8	-0.777D-04	0.321D-05	-0.167D-03	0.751D-04	0.183D-03	0.583D-01
10.0	0.894	63.0	0.911D-04	-0.328D-04	0.136D-04	-0.108D-03	0.108D-03	0.344D-01

TABLE XXXVI

RUN ID F-18

COMMENTS F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.30	0.0000D 00	281.	0.0000D 00	216.	0.0000D 00	1.00	216.
0.1000D-02	1.00	-0.538	1.00	-0.2030D-01	1.00	-0.1090D-01	1.00	216.
0.2000D-02	1.00	-1.08	0.999	-0.4060D-01	1.00	-0.2190D-01	1.00	216.
0.3000D-02	0.999	-1.61	0.997	-0.6090D-01	0.999	-0.3280D-01	1.00	216.
0.4000D-02	0.999	-2.15	0.995	-0.8110D-01	0.998	-0.4370D-01	0.999	216.
0.5000D-02	0.998	-2.69	0.992	-0.101	0.998	-0.5460D-01	0.999	215.
0.6000D-02	0.997	-3.23	0.989	-0.121	0.997	-0.6540D-01	0.999	215.
0.7000D-02	0.997	-3.76	0.985	-0.141	0.995	-0.7630D-01	0.998	215.
0.8000D-02	0.995	-4.30	0.980	-0.161	0.994	-0.8710D-01	0.998	215.
0.9000D-02	0.994	-4.83	0.975	-0.180	0.992	-0.9780D-01	0.997	215.
0.1000D-01	0.993	-5.36	0.969	-0.199	0.990	-0.109	0.996	215.
0.2000D-01	0.972	-10.6	0.882	-0.375	0.962	-0.213	0.986	213.
0.3000D-01	0.939	-15.5	0.753	-0.510	0.917	-0.309	0.968	209.
0.4000D-01	0.896	-20.0	0.603	-0.593	0.858	-0.393	0.944	204.
0.5000D-01	0.846	-23.8	0.452	-0.627	0.789	-0.463	0.914	197.
0.6000D-01	0.792	-26.8	0.318	-0.620	0.712	-0.517	0.880	190.
0.7000D-01	0.739	-29.0	0.210	-0.586	0.632	-0.556	0.842	182.
0.8000D-01	0.691	-30.2	0.128	-0.539	0.553	-0.580	0.801	173.
0.9000D-01	0.652	-30.7	0.712D-01	-0.490	0.478	-0.590	0.759	164.
0.100	0.622	-30.7	0.307D-01	-0.444	0.408	-0.589	0.717	155.
0.200	0.411	-32.6	-0.623D-01	-0.161	0.830D-01	-0.411	0.419	90.4
0.300	0.327	-21.2	-0.414D-01	-0.919D-01	-0.163D-01	-0.308	0.308	66.4
0.400	0.320	-12.8	-0.342D-01	-0.676D-01	-0.574D-01	-0.230	0.237	51.0
0.500	0.314	-9.62	-0.362D-01	-0.522D-01	-0.859D-01	-0.183	0.203	43.7
0.600	0.341	-8.83	-0.426D-01	-0.404D-01	-0.105	-0.136	0.172	37.2
0.700	0.341	-7.62	-0.418D-01	-0.272D-01	-0.111	-0.954D-01	0.146	31.6
0.800	0.293	-8.48	-0.345D-01	-0.123D-01	-0.110	-0.590D-01	0.125	27.0
0.900	0.299	-5.03	-0.302D-01	-0.697D-02	-0.985D-01	-0.321D-01	0.104	22.3
1.00	0.287	-0.895	-0.265D-01	-0.245D-02	-0.922D-01	-0.998D-02	0.927D-01	20.0

TABLE XXXVI

RUN ID F-18

CONTD.

DEAD TIME= 0.0000 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.169	53.2	-0.224D-02	.0.103D-02	-0.308D-02	0.143D-01	0.146D-01	3.15
3.00	0.306	116.	-0.480D-03	0.143D-03	0.110D-02	0.121D-02	0.164D-02	0.353
4.00	0.571	108.	-0.453D-03	-0.429D-03	-0.468D-03	0.988D-03	0.109D-02	0.236
5.00	0.726	107.	-0.513D-03	-0.706D-04	0.117D-03	0.704D-03	0.714D-03	0.154
6.00	0.696	-177.	-0.175D-03	0.745D-04	0.244D-03	-0.121D-03	0.273D-03	0.588D-01
7.00	0.506	-47.7	-0.271D-03	-0.100D-03	-0.213D-03	-0.529D-03	0.570D-03	0.123
8.00	2.81	40.5	-0.245D-03	0.843D-04	-0.468D-04	0.795D-04	0.922D-04	0.199D-01
9.00	0.181	90.4	-0.421D-04	0.156D-04	0.881D-04	0.232D-03	0.248D-03	0.536D-01
10.0	0.452	53.0	-0.393D-04	-0.826D-04	-0.198D-03	-0.406D-04	0.202D-03	0.436D-01

TABLE XXXVI CONTD.

RUN ID F-18

COMMENTS F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.30	0.0000D 00	281.	0.0000D 00	216.	0.0000D 00	1.00	216.
0.1000D-02	1.00	-0.602	1.00	-0.2140D-01	1.00	-0.1090D-01	1.00	216.
0.2000D-02	1.00	-1.20	0.999	-0.4280D-01	1.00	-0.2190D-01	1.00	216.
0.3000D-02	0.999	-1.80	0.997	-0.6420D-01	0.999	-0.3280D-01	1.00	216.
0.4000D-02	0.999	-2.40	0.995	-0.8540D-01	0.998	-0.4370D-01	0.999	216.
0.5000D-02	0.998	-3.00	0.992	-0.107	0.998	-0.5460D-01	0.999	215.
0.6000D-02	0.997	-3.60	0.988	-0.128	0.997	-0.6540D-01	0.999	215.
0.7000D-02	0.997	-4.20	0.984	-0.148	0.995	-0.7630D-01	0.998	215.
0.8000D-02	0.995	-4.80	0.979	-0.169	0.994	-0.8710D-01	0.998	215.
0.9000D-02	0.994	-5.40	0.973	-0.190	0.992	-0.9780D-01	0.997	215.
0.1000D-01	0.993	-5.99	0.967	-0.210	0.990	-0.109	0.996	215.
0.2000D-01	0.972	-11.8	0.873	-0.394	0.962	-0.213	0.986	213.
0.3000D-01	0.939	-17.4	0.736	-0.534	0.917	-0.309	0.968	209.
0.4000D-01	0.896	-22.5	0.576	-0.619	0.858	-0.393	0.944	204.
0.5000D-01	0.846	-26.9	0.417	-0.651	0.789	-0.463	0.914	197.
0.6000D-01	0.792	-30.6	0.277	-0.640	0.712	-0.517	0.880	190.
0.7000D-01	0.739	-33.4	0.164	-0.601	0.632	-0.556	0.842	182.
0.8000D-01	0.691	-35.3	0.8060D-01	-0.548	0.553	-0.580	0.801	173.
0.9000D-01	0.652	-36.4	0.2240D-01	-0.494	0.478	-0.590	0.759	164.
0.100	0.622	-37.0	-0.1830D-01	-0.445	0.408	-0.589	0.717	155.
0.200	0.411	-45.2	-0.9580D-01	-0.143	0.8300D-01	-0.411	0.419	90.4
0.300	0.327	-40.1	-0.6900D-01	-0.7360D-01	-0.1630D-01	-0.308	0.308	66.4
0.400	0.320	-38.0	-0.5970D-01	-0.4660D-01	-0.5740D-01	-0.230	0.237	51.0
0.500	0.314	-41.1	-0.5810D-01	-0.2560D-01	-0.8590D-01	-0.183	0.203	43.7
0.600	0.341	-46.6	-0.5840D-01	-0.5820D-02	-0.105	-0.136	0.172	37.2
0.700	0.341	-51.7	-0.4900D-01	0.9590D-02	-0.111	-0.9540D-01	0.146	31.6
0.800	0.293	-58.9	-0.3150D-01	0.1880D-01	-0.110	-0.5900D-01	0.125	27.0
0.900	0.299	-61.8	-0.2240D-01	0.2140D-01	-0.9850D-01	-0.3210D-01	0.104	22.3
1.00	0.287	-63.9	-0.1420D-01	0.2250D-01	-0.9220D-01	-0.9980D-02	0.9270D-01	20.0

TABLE XXXVI

RUN ID F-18

CONTD.

DEAD TIME= 1.10 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.169	-72.9	0.215D-02	0.121D-02	-0.308D-02	0.143D-01	0.146D-01	3.15
3.00	0.306	-73.5	0.451D-03	-0.217D-03	0.110D-02	0.121D-02	0.164D-02	0.353
4.00	0.571	-144.	0.547D-03	-0.300D-03	-0.468D-03	0.988D-03	0.109D-02	0.236
5.00	0.726	152.	-0.314D-03	-0.412D-03	0.117D-03	0.704D-03	0.714D-03	0.154
6.00	0.696	165.	-0.143D-03	0.125D-03	0.244D-03	-0.121D-03	0.273D-03	0.588D-01
7.00	0.506	-129.	-0.141D-03	0.252D-03	-0.213D-03	-0.529D-03	0.570D-03	0.123
8.00	2.81	-104.	0.248D-03	0.752D-04	-0.468D-04	0.795D-04	0.922D-04	0.199D-01
9.00	0.181	-117.	0.303D-04	-0.331D-04	0.881D-04	0.232D-03	0.248D-03	0.536D-01
10.0	0.452	143.	0.824D-04	-0.396D-04	-0.198D-03	-0.406D-04	0.202D-03	0.436D-01

TABLE XXXVII

RUN ID F-20

COMMENTS F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 5 LINE APP 1/22/69

DEAD TIME= 0.0000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
0.0000D 00	1.12	0.0000D 00	510.	0.0000D 00	454.	0.0000D 00	1.00	454.
0.1000D-02	1.00	-0.507	1.00	-0.227D-01	1.00	-0.139D-01	1.00	454.
0.2000D-02	1.00	-1.01	0.998	-0.454D-01	0.999	-0.278D-01	1.00	454.
0.3000D-02	0.999	-1.52	0.996	-0.680D-01	0.998	-0.416D-01	0.999	454.
0.4000D-02	0.999	-2.03	0.993	-0.905D-01	0.997	-0.554D-01	0.999	454.
0.5000D-02	0.998	-2.53	0.990	-0.113	0.996	-0.692D-01	0.998	454.
0.6000D-02	0.997	-3.03	0.985	-0.135	0.994	-0.829D-01	0.997	453.
0.7000D-02	0.996	-3.53	0.980	-0.157	0.992	-0.965D-01	0.996	453.
0.8000D-02	0.995	-4.03	0.974	-0.178	0.989	-0.110	0.995	452.
0.9000D-02	0.993	-4.53	0.967	-0.200	0.986	-0.124	0.994	452.
0.1000D-01	0.992	-5.02	0.960	-0.221	0.983	-0.137	0.993	451.
0.2000D-01	0.969	-9.74	0.850	-0.404	0.935	-0.263	0.971	442.
0.3000D-01	0.935	-13.9	0.701	-0.528	0.863	-0.369	0.938	426.
0.4000D-01	0.897	-17.3	0.544	-0.591	0.774	-0.449	0.895	407.
0.5000D-01	0.861	-19.9	0.402	-0.606	0.680	-0.503	0.845	384.
0.6000D-01	0.831	-22.2	0.285	-0.594	0.588	-0.532	0.793	361.
0.7000D-01	0.807	-24.5	0.189	-0.568	0.506	-0.543	0.742	337.
0.8000D-01	0.784	-27.2	0.109	-0.534	0.434	-0.542	0.695	316.
0.9000D-01	0.756	-30.3	0.412D-01	-0.491	0.375	-0.534	0.653	297.
0.100	0.717	-33.3	-0.114D-01	-0.442	0.325	-0.524	0.616	280.
0.200	0.428	-36.6	-0.824D-01	-0.142	0.427D-01	-0.381	0.383	174.
0.300	0.331	-27.9	-0.557D-01	-0.716D-01	-0.476D-01	-0.270	0.274	125.
0.400	0.294	-13.2	-0.393D-01	-0.502D-01	-0.910D-01	-0.197	0.217	98.5
0.500	0.309	-4.65	-0.380D-01	-0.405D-01	-0.112	-0.141	0.180	81.7
0.600	0.331	-2.56	-0.410D-01	-0.284D-01	-0.120	-0.910D-01	0.150	68.4
0.700	0.358	-5.83	-0.437D-01	-0.126D-01	-0.118	-0.475D-01	0.127	57.7
0.800	0.297	-10.4	-0.319D-01	0.154D-02	-0.107	-0.142D-01	0.108	48.9
0.900	0.248	-19.4	-0.197D-01	0.911D-02	-0.872D-01	0.823D-02	0.876D-01	39.8
1.00	0.199	-17.0	-0.120D-01	0.896D-02	-0.711D-01	0.254D-01	0.755D-01	34.3

TABLE XXXVII

RUN ID F-20

CONTD.

DEAD TIME= 0.000D 00 PULSES NORMALIZED

OMEGA RAD/SEC	AMPLITUDE RATIO	PHASE ANGLE DEGREES	OUTPUT PULSE REAL	OUTPUT PULSE IMAGINARY	INPUT PULSE REAL	INPUT PULSE IMAGINARY	INPUT FREQ CONTENT NORMALIZED	INPUT FREQ CONTENT ACTUAL
2.00	0.269	154.	-0.198D-02	-0.106D-02	0.487D-02	0.679D-02	0.835D-02	3.80
3.00	0.228	155.	-0.298D-03	0.233D-03	0.162D-02	-0.377D-03	0.166D-02	0.754
4.00	0.581	-5.11	-0.482D-03	-0.243D-03	-0.789D-03	-0.491D-03	0.930D-03	0.423
5.00	0.642	-2.15	-0.227D-03	0.298D-03	-0.371D-03	0.451D-03	0.583D-03	0.265
6.00	0.773	-91.4	-0.170D-03	-0.289D-04	0.429D-04	-0.219D-03	0.223D-03	0.101
7.00	0.184	-34.8	-0.625D-04	-0.232D-04	-0.207D-03	-0.297D-03	0.362D-03	0.164
8.00	0.279	-11.9	-0.161D-03	0.365D-04	-0.592D-03	0.871D-05	0.592D-03	0.269
9.00	0.227	49.7	-0.677D-04	-0.358D-05	-0.205D-03	0.217D-03	0.299D-03	0.136
10.0	0.727	118.	-0.874D-04	-0.861D-05	0.469D-04	0.111D-03	0.121D-03	0.549D-01

TABLE XXXVII CONTD.

RUN ID F-20

COMMENTS F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 5 LINE APP 1/22/69

DEAD TIME= 0.700 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT	PULSE	INPUT	PULSE	INPUT FREQ	CONTENT
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
0.000D 00	1.12	0.000D 00	510.	0.000D 00	454.	0.000D 00	1.00	454.
0.100D-02	1.00	-0.548	1.00	-0.234D-01	1.00	-0.139D-01	1.00	454.
0.200D-02	1.00	-1.09	0.998	-0.468D-01	0.999	-0.278D-01	1.00	454.
0.300D-02	0.999	-1.64	0.996	-0.701D-01	0.998	-0.416D-01	0.999	454.
0.400D-02	0.999	-2.19	0.993	-0.933D-01	0.997	-0.554D-01	0.999	454.
0.500D-02	0.998	-2.73	0.989	-0.116	0.996	-0.692D-01	0.998	454.
0.600D-02	0.997	-3.27	0.985	-0.139	0.994	-0.829D-01	0.997	453.
0.700D-02	0.996	-3.82	0.979	-0.162	0.992	-0.965D-01	0.996	453.
0.800D-02	0.995	-4.35	0.973	-0.184	0.989	-0.110	0.995	452.
0.900D-02	0.993	-4.89 .03	0.966	-0.206	0.986	-0.124	0.994	452.
0.100D-01	0.992	-5.42 .029	0.958	-0.227	0.983	-0.137	0.993	451.
0.200D-01	0.969	-10.5 .06	0.844	-0.416	0.935	-0.263	0.971	442.
0.300D-01	0.935	-15.1 .05	0.689	-0.543	0.863	-0.369	0.938	426.
0.400D-01	0.897	-18.9 .11	0.527	-0.606	0.774	-0.449	0.895	407.
0.500D-01	0.861	-22.0 .14	0.381	-0.620	0.680	-0.503	0.845	384.
0.600D-01	0.831	-24.6	0.260	-0.606	0.588	-0.532	0.793	361.
0.700D-01	0.807	-27.3	0.161	-0.577	0.506	-0.543	0.742	337.
0.800D-01	0.784	-30.4	0.787D-01	-0.539	0.434	-0.542	0.695	316.
0.900D-01	0.756	-33.9	0.102D-01	-0.493	0.375	-0.534	0.653	297.
0.100	0.717	-37.3	-0.423D-01	-0.440	0.325	-0.524	0.616	280.
0.200	0.428	-44.6	-0.101	-0.129	0.427D-01	-0.381	0.383	174.
0.300	0.331	-39.9	-0.694D-01	-0.584D-01	-0.476D-01	-0.270	0.274	125.
0.400	0.294	-29.2	-0.516D-01	-0.374D-01	-0.910D-01	-0.197	0.217	98.5
0.500	0.309	-24.7	-0.496D-01	-0.251D-01	-0.112	-0.141	0.180	81.7
0.600	0.331	-26.6	-0.490D-01	-0.919D-02	-0.120	-0.910D-01	0.150	68.4
0.700	0.358	-33.9	-0.445D-01	0.939D-02	-0.118	-0.475D-01	0.127	57.7
0.800	0.297	-42.5	-0.262D-01	0.183D-01	-0.107	-0.142D-01	0.108	48.9
0.900	0.248	-55.5	-0.106D-01	0.190D-01	-0.872D-01	0.823D-02	0.876D-01	39.8
1.00	0.199	-57.1	-0.343D-02	0.146D-01	-0.711D-01	0.254D-01	0.755D-01	34.3

TABLE XXXVII

RUN ID F-20

CONTD.

DEAD TIME= 0.700 PULSES NORMALIZED

OMEGA	AMPLITUDE	PHASE ANGLE	OUTPUT PULSE		INPUT PULSE		INPUT FREQ CONTENT	
RAD/SEC	RATIO	DEGREES	REAL	IMAGINARY	REAL	IMAGINARY	NORMALIZED	ACTUAL
2.00	0.269	73.6	-0.138D-02	0.177D-02	0.487D-02	0.679D-02	0.835D-02	3.80
3.00	0.228	34.7	0.352D-03	0.139D-03	0.162D-02	-0.377D-03	0.166D-02	0.754
4.00	0.581	-166.	0.372D-03	0.391D-03	-0.789D-03	-0.491D-03	0.930D-03	0.423
5.00	0.642	157.	0.108D-03	-0.359D-03	-0.371D-03	0.451D-03	0.583D-03	0.265
6.00	0.773	27.9	0.108D-03	-0.134D-03	0.429D-04	-0.219D-03	0.223D-03	0.101
7.00	0.184	44.5	0.111D-04	-0.657D-04	-0.207D-03	-0.297D-03	0.362D-03	0.164
8.00	0.279	27.2	-0.148D-03	-0.736D-04	-0.592D-03	0.871D-05	0.592D-03	0.269
9.00	0.227	48.7	-0.677D-04	-0.244D-05	-0.205D-03	0.217D-03	0.299D-03	0.136
10.0	0.727	77.4	-0.715D-04	0.509D-04	0.469D-04	0.111D-03	0.121D-03	0.549D-01

IRTRAN ** STOP

?.607
?.264,.241,0.6,0.22,0.,0.542,46.8,4.25,0.599,1.0,1.0,0.052
3.1889427E-01

0.264	0.241	0.319	0.220
0.542	0.542	46.8	4.25
0.599	0.241	1.00	1.00

V

FREQUENCY	MAGNITUDE	ANGLE
0.100E-01	0.992	-5.61
0.150E-01	0.982	-8.35
0.200E-01	0.969	-11.0
0.250E-01	0.953	-13.6
0.300E-01	0.934	-16.0
0.400E-01	0.889	-20.5
0.500E-01	0.839	-24.5
0.600E-01	0.787	-27.8
0.700E-01	0.735	-30.4
0.800E-01	0.685	-32.5
0.900E-01	0.637	-34.0
0.100	0.592	-35.0
0.150	0.425	-32.2
0.200	0.354	-20.3
0.250	0.358	-8.96
0.300	0.391	-4.49
0.400	0.423	-7.49
0.500	0.391	-9.30
0.600	0.374	-4.99
0.700	0.386	-2.85
0.800	0.390	-3.68
0.900	0.381	-3.86
1.00	0.376	-3.16
1.50	0.355	-2.17
2.00	0.325	-1.79?0

$V_f = .319$

$V_d = .281$

$V_b = 0.4$

PRØGRAM STØP AT 860

```
?.646
?.399,.241,0.37,0.22,0.,0.542,46.8,4.25,0.599,0.5,1.0,0.05
```

I

0.399	0.241	0.370	0.220
0.521	0.542	46.8	4.25
0.599	0.326	0.500	1.00

FREQUENCY	MAGNITUDE	ANGLE
0.100E-01	0.995	-4.51
0.150E-01	0.989	-6.72
0.200E-01	0.981	-8.90
0.250E-01	0.971	-11.0
0.300E-01	0.959	-13.1
0.400E-01	0.930	-17.0
0.500E-01	0.897	-20.6
0.600E-01	0.861	-23.8
0.700E-01	0.823	-26.7
0.800E-01	0.785	-29.2
0.900E-01	0.748	-31.4
0.100	0.712	-33.2
0.150	0.559	-38.7
0.200	0.449	-39.6
0.250	0.372	-37.0
0.300	0.322	-31.6
0.400	0.288	-17.8
0.500	0.305	-9.63
0.600	0.325	-8.44
0.700	0.329	-9.94
0.800	0.319	-11.0
0.900	0.305	-10.3
1.00	0.297	-8.53
1.50	0.289	-5.19
2.00	0.269	-4.21?0

$V_p = 0.370$

$V_b = .630$

$V_d = 0.D.$

PRØGRAM STØP AT 860

```
?.620
?.309,.241,0.5,0.22,0.,0.542,46.8,4.25,0.599,0.8,1.0,0.052
   3.4897843E-01
```

V

0.309	0.241	0.349	0.220
0.542	0.542	46.8	4.25
0.599	0.241	0.800	1.00

FREQUENCY	MAGNITUDE	ANGLE
0.100E-01	0.993	-5.37
0.150E-01	0.983	-8.00
0.200E-01	0.971	-10.6
0.250E-01	0.956	-13.0
0.300E-01	0.938	-15.4
0.400E-01	0.897	-19.7
0.500E-01	0.851	-23.5
0.600E-01	0.803	-26.7
0.700E-01	0.755	-29.3
0.800E-01	0.708	-31.5
0.900E-01	0.664	-33.1
0.100	0.623	-34.4
0.150	0.461	-34.7
0.200	0.367	-27.5
0.250	0.334	-16.5
0.300	0.345	-7.77
0.400	0.397	-3.91
0.500	0.406	-7.66
0.600	0.379	-8.67
0.700	0.362	-5.52
0.800	0.368	-3.08
0.900	0.374	-3.01
1.00	0.372	-3.50
1.50	0.351	-2.36
2.00	0.327	-1.92?1

$V_f = .349$

$V_d = .151$

$V_b = 0.5$

APPENDIX VI

RAW DATA

TABLE XXXVIII

TOTAL LAG TIMES BETWEEN PULSES
(AS MEASURED FROM THE CHARTS)

FLOW RATE READING, CM	RUN ID	TOTAL LAG TIME SECONDS
2.0	H-03	3.5
	H-04	3.5
	H-05	3.5
	H-06	3.5
	AVG.	3.5
	F-03	27.8
	F-04	27.4
	F-05	27.4
	F-06	27.4
	AVG.	27.5
4.0	H-08	2.5
	H-09	2.5
	H-10	2.6
	H-11	2.7
	AVG.	2.6
	F-07	14.2
	F-08	14.0
	F-09	12.6
	F-10	13.7
	F-11	13.7
	AVG.	13.6
5.0	H-07	1.9
	H-12	2.2
	H-13	2.2
	H-14	2.2
	AVG.	2.1
	F-02	2.0
	F-11	2.1
	F-12	2.1
	F-13	1.4
	AVG.	1.9

TABLE XXXVIII CONTD.

FLOW RATE READING, CM	RUN ID	TOTAL LAG TIME SECONDS
6.0	H-15	2.3
	H-16	1.9
	H-17	2.2
	H-18	2.4
	AVG.	2.2
	F-14	1.9
	F-15	2.0
	F-16	2.0
	F-17	2.1
	AVG.	2.0
8.0	H-19	2.3
	H-20	2.0
	H-21	1.9
	H-22	1.9
	AVG.	2.0
	F-18	1.1
	F-19	0.8
	F-20	0.7
	F-21	0.9
	AVG.	0.9

204030.25201.0000204030.25221.000110.650.01 101.0 0.5 0.5 H-01

HE TRACER BED IN AIR RATE 6.3 CM 12/27/68

0.5	0.5	7.0	20.5	31.5	39.5	42.3	42.0	39.8	35.9	32.2	28.8
25.9	23.0	20.2	17.7	15.9	14.3	12.8	11.6	10.5	9.6	6.5	4.8
3.4	2.6	2.1	1.7	1.4	1.3	1.2	1.0	1.0	0.9	0.7	0.7
0.6	0.6	0.5									
1.0	1.0	2.0	5.0	10.0	17.0	24.5	29.7	34.4	38.8	40.9	41.7
41.3	40.0	37.7	34.8	31.9	28.8	25.8	23.1	20.5	18.2	16.1	14.5
9.2	6.1	4.3	3.1	2.5	2.0	1.7	1.6	1.5	1.4	1.3	1.3
1.2	1.1	1.0									

204040.25241.0000205030.25261.000110.550.01 101.0 0.2 0.2 H-02

HE TRACER BED HT 7 3/8 IN AIR RATE 6.3 CM LINE APPROX 1/2/69

0.3	0.3	5.0	14.5	24.0	30.0	33.0	33.1	31.2	28.7	25.8	22.8
19.8	17.3	15.2	13.6	12.0	10.7	9.5	8.7	7.8	7.0	6.3	5.8
5.2	4.8	3.3	2.4	1.8	1.3	1.1	0.9	0.8	0.7	0.6	0.5
0.5	0.4	0.4	0.3								
0.2	0.2	1.7	4.8	9.0	16.0	23.5	29.0	33.4	36.3	37.6	37.9
37.2	35.3	32.5	29.2	26.5	23.7	20.9	18.4	16.2	14.2	12.4	11.1
9.7	8.6	7.6	6.7	4.2	3.8	1.9	1.3	1.1	0.8	0.7	0.6
0.6	0.5	0.5	0.45	0.45	0.4	0.4	0.35	0.35	0.3	0.3	0.3
0.25	0.25	0.2									

207030.25341.0000207020.25321.000112.060.01 101.0 0.5 0.5 H-03

HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SAMPLE LOOP 1 LINE APP 1/6/69

0.6	0.6	4.0	15.0	27.0	38.0	44.0	45.5	44.8	42.0	38.7	34.8
31.6	28.3	25.0	22.2	20.1	18.2	16.3	14.8	13.4	12.2	11.1	10.2
9.4	8.7	8.1	7.5	7.0	6.6	6.3	6.0	5.7	5.4	5.2	5.0
4.3	3.9	3.4	3.1	2.7	2.4	2.2	2.0	1.9	1.8	1.7	1.6
1.4	1.3	1.25	1.2	1.15	1.0	1.05	1.0	1.0	1.0	0.9	0.9
0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.75	0.7	0.7	0.7	0.7
0.7	0.65	0.6									
0.5	0.5	1.3	5.1	12.5	23.5	33.5	39.2	42.1	42.0	40.3	37.7
34.9	31.8	28.4	25.2	22.9	20.7	18.6	16.8	15.1	13.7	12.3	11.3
10.2	9.4	8.6	8.0	7.4	6.9	6.5	6.2	5.8	5.5	4.6	4.2
3.5	3.1	2.8	2.5	2.2	2.0	1.9	1.8	1.7	1.5	1.4	1.3
1.25	1.2	1.15	1.1	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.8
0.8	0.75	0.75	0.75	0.75	0.75	0.7	0.7	0.65	0.65	0.6	0.6
0.6	0.5										

206100.25301.0000206100.25321.000112.060.01 101.0 0.5 0.5 H-04

HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 1 LINE APP 1/6/69

0.6	0.6	4.1	16.3	29.6	40.5	46.2	47.5	46.2	43.0	39.8	35.5
32.2	28.8	25.3	22.5	20.3	18.3	16.5	15.0	13.5	12.2	11.2	10.3
9.4	8.8	8.0	7.5	7.0	6.6	6.2	6.0	5.0	4.2	3.7	3.2
2.8	2.6	2.3	2.1	1.9	1.8	1.7	1.5	1.3	1.25	1.2	1.15
1.1	1.05	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.8
0.8	0.75	0.75	0.75	0.75	0.70	0.70	0.65	0.65	0.60		
0.6	0.6	1.3	5.5	13.1	24.9	35.0	41.1	43.9	43.9	42.1	39.1
36.3	33.0	29.5	26.2	23.8	21.3	19.1	17.2	15.6	14.0	12.6	11.5
10.3	9.6	8.7	8.0	7.5	7.0	6.5	6.2	5.8	5.5	4.6	3.9
3.4	3.0	2.7	2.4	2.2	2.0	1.8	1.7	1.6	1.5	1.4	1.3
1.25	1.2	1.2	1.1	1.0	1.0	1.0	0.95	0.9	0.9	0.85	0.8
0.8	0.8	0.8	0.8	0.8	0.75	0.70	0.70	0.65	0.60		

205110.25301.0000206020.25281.000112.100.01 101.0 0.2 0.2 H-05

HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

0.1	0.1	4.2	12.0	19.6	25.8	28.5	28.9	27.8	25.3	23.2	20.9
18.9	16.8	14.8	13.1	11.8	10.5	9.4	8.6	7.8	7.0	6.3	5.8
5.2	4.9	4.5	4.2	3.9	3.7	3.4	3.2	2.7	2.2	2.0	1.7
1.5	1.3	1.2	1.0	0.9	0.85	0.8	0.7	0.65	0.6	0.55	0.5
0.5	0.4	0.4	0.35	0.35	0.35	0.3	0.3	0.25	0.2	0.1	
0.0	0.0	1.2	5.3	11.0	18.5	24.0	27.0	28.0	27.3	25.9	23.8
21.8	19.8	17.4	15.5	13.9	12.5	11.1	10.0	8.9	8.1	7.2	6.5
5.9	5.3	4.8	4.4	4.1	3.9	3.0	2.4	2.0	1.8	1.5	1.3
1.2	1.0	0.9	0.8	0.75	0.7	0.6	0.55	0.5	0.45	0.4	0.35
0.3	0.3	0.3	0.3	0.25	0.25	0.25	0.2	0.2	0.1	0.1	0.1
0.1	0.0										

206020.25241.0000206030.25261.000112.050.01   101.0 0.2   0.2   H-06

HE TRACER BED HT 7 1/4 IN PACKED AIR FLOW 2.0 CM SMP LOOP 2 LINE APP   1/6/69

0.0	0.0	3.8	12.0	19.1	25.0	27.8	28.1	27.0	24.8	22.7	20.2
18.2	16.1	14.2	12.7	11.3	10.2	9.2	8.3	7.6	6.8	6.1	5.7
5.1	4.8	3.6	2.9	2.3	2.0	1.8	1.5	1.3	1.2	1.1	1.0
0.9	0.8	0.75	0.7	0.7	0.6	0.6	0.5	0.5	0.45	0.4	0.4
0.4	0.4	0.35	0.35	0.3	0.3	0.25	0.25	0.2	0.2	0.2	0.2
0.1	0.0										

0.0	0.0	0.8	4.0	9.5	16.8	23.0	26.4	28.0	27.6	26.3	24.2
22.3	20.2	18.0	15.9	14.2	12.8	11.3	10.2	9.2	8.2	7.3	6.7
6.0	5.5	5.0	4.6	3.3	2.7	2.2	1.8	1.6	1.3	1.2	1.0
0.9	0.8	0.75	0.7	0.6	0.55	0.5	0.45	0.4	0.4	0.3	0.3
0.25	0.25	0.25	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.05	0.05
0.05	0.05	0.0									

205080.25291.0000205080.25341.000110.480.001 10.0 0.5 0.5 H-07

HE BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 2 LINE APP 1/9/69

1.3	1.3	6.0	17.5	31.5	41.3	45.0	45.3	42.8	39.5	35.5	32.1
28.7	25.1	22.0	19.8	17.8	16.0	14.3	12.9	11.6	10.5	9.6	8.7
8.0	7.4	7.0	6.5	6.1	5.5	5.2	4.0	3.4	2.8	2.6	2.3
2.3	2.2	2.0	2.0	1.9	1.8	1.8	1.75	1.7	1.7	1.6	1.6
1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.3				
1.0	1.0	3.2	7.7	12.1	17.8	23.0	27.3	31.2	34.9	37.2	39.4
40.2	39.8	38.0	35.3	32.9	30.0	27.0	24.3	21.7	19.1	17.0	15.2
13.4	12.2	10.7	9.7	8.7	8.0	7.1	6.5	5.9	5.3	5.0	4.5
3.3	2.7	2.4	2.1	1.9	1.8	1.7	1.6	1.55	1.5	1.45	1.4
1.3	1.25	1.25	1.2	1.2	1.1	1.1	1.0				

205040.25281.0000205060.25301.000111.100.001 10.0 0.5 0.5 H-08

HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

0.0	0.0	4.8	16.9	28.6	37.6	41.7	42.0	40.0	36.3	33.0	29.3
26.3	23.4	20.4	17.9	16.0	14.2	12.7	11.4	10.3	9.2	8.2	7.4
6.6	6.0	5.4	4.9	4.5	4.1	2.9	2.2	1.6	1.3	1.1	0.9
0.75	0.65	0.5	0.5	0.4	0.35	0.3	0.25	0.25	0.2	0.2	0.1
0.1	0.05	0.05	0.0								
0.5	0.5	3.5	13.0	24.5	33.8	38.2	38.7	37.1	34.0	31.2	27.9
25.0	22.2	19.4	17.0	15.1	13.5	11.9	10.6	9.5	8.4	7.5	6.8
6.1	5.5	5.0	4.5	4.2	3.8	3.5	3.2	2.4	2.0	1.7	1.4
1.25	1.2	1.1	1.0	0.95	0.9	0.8	0.8	0.8	0.75	0.7	0.7
0.7	0.6	0.6	0.55	0.55	0.5						

206060.25401.0000205040.25281.000111.100.001 10.0 0.5 0.5 H-09

HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 2 LINE APP 1/7/69

0.0	0.0	4.0	16.0	28.0	37.0	41.3	41.6	39.9	36.2	33.0	29.3
26.2	23.2	20.2	17.8	16.0	14.2	12.7	11.3	10.1	9.1	8.2	7.4
6.6	6.0	5.4	5.0	4.5	4.2	3.8	3.5	3.2	3.0	2.75	2.5
2.25	2.1	2.0	1.9	1.8	1.7	1.4	1.1	0.9	0.8	0.7	0.6
0.55	0.45	0.4	0.35	0.35	0.3	0.3	0.25	0.25	0.25	0.2	0.2
0.1	0.1	0.1	0.05	0.05	0.0						
0.4	0.4	3.6	15.0	28.0	38.0	42.9	43.4	41.8	38.1	34.8	31.0
27.8	24.8	21.8	19.0	16.9	15.0	13.1	11.7	10.3	9.2	8.2	7.3
6.6	5.9	5.3	4.9	4.4	4.0	3.0	2.2	1.8	1.5	1.3	1.2
1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.75	0.7	0.7	0.7	0.65
0.6	0.5	0.45	0.4								

204100.25281.0000205010.25301.000111.200.001 10.0 0.5 0.5 H-10

HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

0.4	0.4	6.0	18.5	29.5	37.4	40.6	40.4	38.0	34.1	30.8	27.1
24.1	21.2	18.6	16.2	14.3	12.8	11.3	10.2	9.1	8.2	7.3	6.6
5.9	5.3	4.8	4.4	4.0	3.7	2.7	2.0	1.6	1.3	1.25	1.0
0.9	0.8	0.75	0.7	0.6	0.55	0.5	0.5	0.45	0.4		
0.7	0.7	3.7	14.8	27.0	38.2	43.7	44.4	42.9	39.2	35.8	31.9
28.6	25.2	22.0	19.1	16.9	14.9	13.0	11.6	10.2	9.0	8.0	7.2
6.3	5.7	5.0	4.6	4.2	3.8	3.4	3.2	2.3	1.8	1.5	1.3
1.2	1.1	1.0	0.9	0.8	0.8	0.8	0.75	0.75	0.75	0.75	0.75
0.7											

204110.25281.0000204110.25291.000111.300.001 10.0 0.5 0.5 H-11

HE PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

0.4	0.4	4.8	16.5	28.0	31.5	40.3	40.3	38.3	34.6	31.2	27.6
24.6	21.8	18.8	16.3	14.6	13.0	11.6	10.4	9.2	8.3	7.4	6.7
6.0	5.4	4.9	4.5	4.1	3.8	2.7	2.1	1.7	1.4	1.2	1.0
0.9	0.8	0.75	0.7	0.7	0.65	0.6	0.55	0.5	0.45	0.4	
0.75	0.75	5.0	17.0	29.5	39.0	43.0	43.1	41.0	37.3	34.0	30.1
27.0	23.9	20.9	17.2	16.1	14.2	12.5	11.0	8.7	7.8	7.0	6.2
5.6	5.0	4.5	4.1	3.8	3.5	3.2	2.4	1.9	1.6	1.4	1.3
1.2	1.1	1.0	1.0	1.0	0.9	0.85	0.85	0.8	0.8	0.75	

204120.25281.0000205110.25361.000111.800.001 10.0 0.5 0.5 H-12

HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 2 LINE APP 1/9/69

1.1	1.1	6.4	19.0	30.0	38.5	42.0	42.0	39.8	35.9	32.5	28.9
25.9	23.0	20.4	18.1	16.2	14.8	13.2	12.0	11.0	10.0	9.0	8.3
7.6	7.0	6.2	5.9	5.5	5.2	4.0	3.3	2.9	2.5	2.2	2.0
1.9	1.8	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.3	1.2	1.1
1.0	1.0	2.5	5.9	9.8	14.5	19.2	22.8	25.9	29.1	30.9	31.1
30.3	28.9	26.7	24.2	22.2	20.2	18.0	16.2	14.5	13.0	11.7	10.6
9.5	8.7	7.8	7.1	6.4	6.0	5.4	5.0	4.6	4.3	4.0	3.7
3.4	3.2	2.7	2.2	2.0	1.8	1.7	1.6	1.5	1.5	1.4	1.4
1.3	1.3	1.25	1.2	1.2	1.15	1.15	1.1	1.05	1.05	1.0	

204050.25231.0000204120.25321.000110.800.001 10.0 0.2 0.2 H-13

HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SHP LOOP 3 LINE APP 1/9/69

0.7	0.7	4.5	13.9	23.0	30.0	33.0	33.0	31.2	28.2	25.4	22.5
20.0	17.8	15.4	13.5	12.1	10.8	9.7	8.8	7.2	6.4	5.9	5.2
4.8	3.4	2.6	2.0	1.6	1.5	1.3	1.1	1.0	1.0	0.9	0.9
0.8	0.8	0.8	0.75	0.7							
1.0	1.0	1.5	2.2	3.5	5.8	8.1	11.5	17.0	23.0	27.1	30.0
30.9	30.7	29.2	27.0	24.9	22.4	20.0	17.9	15.9	13.9	12.2	11.0
9.7	8.8	7.7	7.0	6.3	5.7	5.2	4.7	4.3	3.9	2.9	2.3
2.0	1.7	1.6	1.5	1.4	1.35	1.3	1.25	1.2	1.1	1.05	1.0

204070.25261.0000204120.25301.000110.800.001 10.0 0.2 0.2 H-14

HE FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 3 LINE APP 1/9/69

22.0	19.4	16.9	14.9	13.2	11.9	10.5	9.5	8.5	7.6	6.9	6.3
5.6	5.2	4.7	4.2	3.1	2.4	1.8	1.6	1.4	1.25	1.1	1.05
1.0	1.0	0.9	0.9	0.8	0.8	0.7					
1.1	1.1	1.8	3.5	6.0	9.7	13.2	16.0	17.9	22.1	24.7	26.8
27.5	27.2	25.9	24.0	22.0	20.0	18.0	16.1	14.4	12.9	11.4	10.3
9.1	8.2	7.3	6.6	6.0	5.5	5.0	4.6	3.3	2.6	2.2	1.8
1.7	1.6	1.5	1.4	1.35	1.3	1.2	1.2	1.2	1.15	1.15	1.1

204020.25241.0000204070.25281.000110.900.001 10.0 0.5 0.5 H-15

HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 2 LINE APP 1/22/69

0.5	0.5	5.8	16.0	25.0	31.2	33.5	33.2	31.4	28.3	25.8	22.7
20.1	17.8	15.5	13.6	12.2	11.0	9.9	8.9	8.0	7.3	6.6	6.0
5.3	5.0	3.4	2.6	1.9	1.5	1.2	1.1	0.9	0.8	0.7	0.7
0.6	0.5										
0.5	0.5	1.8	6.8	12.6	19.0	23.9	26.7	28.6	29.8	29.9	29.1
27.9	2.61	23.9	21.7	19.8	17.8	15.8	14.1	12.5	11.1	9.8	8.8
7.8	6.9	6.1	5.4	4.9	4.3	2.8	2.0	1.4	1.1	0.9	0.8
0.75	0.7	0.65	0.6	0.55	0.55	0.5					

204040.25241.0000204020.25261.000110.800.001 10.0 0.2 0.2 H-17

HE FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 3 LINE APP 1/22/69

0.6	0.6	5.9	16.0	24.5	30.3	32.5	32.2	30.2	27.2	24.6	21.7
19.2	17.0	14.8	12.9	11.5	10.3	9.2	8.3	7.5	6.7	6.0	5.5
5.0	4.5	3.2	2.3	1.8	1.4	1.2	1.0	1.0	0.8	0.8	0.75
0.75	0.7	0.65	0.6								
0.6	0.6	1.5	3.3	7.2	13.2	18.9	22.8	25.3	26.5	26.2	25.0
23.7	22.0	20.0	17.9	16.1	14.3	12.8	11.3	10.0	8.9	7.9	7.1
6.2	5.6	4.9	4.4	2.9	2.0	1.5	1.2	1.0	0.9	0.8	0.7
0.65	0.6										

203100.25201.0000203070.25221.000110.850.001 10.0 0.2 0.2 H-19

HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 3 LINE APP 1/22/69

1.1	1.1	5.0	6.8	16.7	19.9	20.9	20.5	19.2	17.2	15.5	13.8
12.3	11.0	9.7	8.5	7.7	7.0	6.2	5.7	5.2	4.8	3.5	2.7
2.2	1.9	1.6	1.4	1.3	1.25	1.2	1.2	1.15	1.1		
1.1	1.1	3.0	7.1	11.6	16.0	19.0	20.2	20.3	19.3	18.0	16.4
15.0	13.5	11.9	10.5	9.4	8.5	7.5	6.8	6.1	5.5	4.9	4.4
3.0	2.25	1.8	1.5	1.4	1.2	1.1					

203120.25221.0000204020.25261.000110.450.001 10.0 0.2 0.2 H-21

HE FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

1.1	1.1	5.4	14.9	21.0	25.8	27.2	26.9	25.2	22.9	20.6	18.2
16.2	14.3	12.7	11.1	10.0	9.0	8.1	7.4	6.8	6.0	5.5	5.1
3.8	2.9	2.4	2.0	1.8	1.6	1.5	1.4	1.3	1.2	1.05	1.1
1.2	1.2	3.2	8.5	14.0	20.0	24.1	26.6	27.6	27.3	26.2	24.8
23.0	21.1	19.0	16.9	15.2	13.7	12.0	10.9	9.7	8.5	7.7	6.9
6.2	5.6	5.0	4.6	3.3	2.5	2.0	1.8	1.6	1.5	1.4	1.3

207020.25221.0000206080.25232.000111.850.01 101.0 1.0 1.0 F-01

FREON-12 TRACER BED IN AIR RATE 6.3 CM 12/27/68

0.0	0.0	1.3	4.8	9.0	14.6	19.5	24.1	28.0	30.3	31.0	30.9
30.2	29.1	27.7	26.3	25.0	24.0	22.7	21.7	20.9	20.1	19.3	19.0
17.0	15.5	14.3	13.2	12.5	11.6	10.8	10.1	9.4	8.7	8.3	7.5
7.0	6.3	6.0	5.7	5.1	4.7	4.2	4.0	3.9	3.4	3.4	2.8
2.6	2.3	2.2	2.0	1.9	1.8	1.5	1.5	1.4	1.3	1.3	1.1
1.0	0.9	0.9	0.8	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.1
0.1	0.0										
1.0	1.0	1.2	1.5	2.0	2.5	3.0	3.7	4.3	5.0	6.0	6.7
7.4	8.1	8.8	9.2	9.6	9.9	10.0	10.1	10.1	10.0	9.9	9.7
9.5	8.1	7.6	7.5	7.2	7.1	7.0	6.9	6.8	6.6	6.3	6.2
6.1	6.0	5.8	5.6	5.5	5.4	5.2	4.8	4.6	4.3	4.0	3.7
3.5	3.2	3.0	2.8	2.6	2.4	2.3	2.2	2.0	1.9	1.8	1.7
1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0				

207020.25482.0000208010.25442.000110.450.001 10.0 0.5 0.5 F-02

F- 12 BED HT 7 1/4 IN FLUIDIZED AIR FLOW 5.0 CM SMP LOOP 5 LINE APP 1/9/69

1.0	1.0	2.0	4.0	7.0	11.0	15.9	20.0	24.1	27.3	29.0	29.9
30.0	29.7	29.0	27.8	26.8	25.7	24.4	23.3	22.3	21.3	20.4	19.7
19.0	18.5	18.0	17.6	17.2	16.8	16.4	16.0	15.6	15.3	15.0	14.7
14.4	14.2	13.9	13.7	13.3	13.1	13.0	12.8	12.6	12.3	12.1	12.0
11.8	11.7	10.9	9.4	8.1	7.3	6.2	5.5	4.8	4.3	3.8	3.2
2.9	2.8	2.2	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1
1.1	1.0										
0.0	0.0	0.3	0.9	1.7	2.8	4.4	6.1	8.0	9.9	11.2	12.1
12.7	13.1	13.2	13.25	13.2	13.1	12.9	12.7	12.3	12.0	11.7	11.4
11.0	10.7	10.35	10.1	9.8	9.6	9.35	9.2	9.0	8.8	8.6	8.4
8.3	8.25	8.2	8.1	8.0	7.9	7.8	7.8	7.8	7.8	7.7	7.7
7.7	7.6	7.7	7.8	8.0	7.8	7.2	7.0	6.4	5.7	5.0	4.3
3.9	3.4	3.0	2.5	2.2	1.9	1.75	1.5	1.3	1.1	1.0	0.8
0.7	0.6	0.5	0.4	0.3	0.25	0.2	0.15	0.15	0.1	0.1	0.05
0.0											

206040.25342.0000203120.25612.0001126.40.001 10.0 0.5 0.5 F-03

F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

0.0	0.0	0.5	1.5	3.0	4.8	7.0	9.2	11.8	14.3	16.2	17.8
19.0	19.8	20.4	20.5	20.4	20.2	19.7	19.2	18.6	18.0	17.3	16.7
16.1	15.6	15.0	14.6	14.1	13.8	13.3	13.0	12.7	12.3	12.1	11.9
10.2	8.9	7.7	6.8	5.9	5.1	4.4	3.8	3.25	2.9	2.4	2.1
1.8	1.6	1.3	1.1	1.0	0.8	0.7	0.6	0.5	0.4	0.3	0.25
0.2	0.15	0.1	0.05	0.0							
0.6	0.6	0.7	0.75	0.8	0.85	0.9	0.95	1.0	1.1	1.2	1.25
1.3	1.5	1.7	1.8	2.0	2.1	2.3	2.5	2.75	3.0	3.25	3.5
3.7	4.0	4.3	4.6	4.9	5.2	5.4	5.7	6.0	6.3	6.6	6.8
7.1	7.3	7.5	7.7	8.0	8.2	8.35	8.5	8.6	8.75	8.9	9.0
9.05	9.1	9.2	9.2	9.2	9.25	9.25	9.25	9.2	9.15	9.1	9.05
9.0	8.95	8.9	8.2	7.4	6.7	6.0	5.3	4.7	4.1	3.7	3.2
2.8	2.5	2.2	2.0	1.8	1.6	1.4	1.3	1.2	1.15	1.1	1.0
1.0	0.9	0.9	0.9	0.8	0.8	0.75	0.75	0.7	0.7	0.65	0.6

206060.25362.0000206120.50302.0001126.00.001 10.0 0.5 0.5 F-04

F-12 PACKED BED HT 7 1/4 IN AIR FLOW 2.0 CM SMP LOOP 2 LINE APP 1/6/69

0.0	0.0	0.7	1.5	2.5	4.2	6.3	8.4	10.8	13.0	14.8	16.3
17.3	18.1	18.6	18.9	18.8	18.6	18.2	17.75	17.2	16.6	15.9	15.3
14.8	14.3	13.8	13.3	13.0	12.7	12.3	12.0	11.7	11.5	11.2	11.0
10.8	10.6	9.1	8.2	7.0	6.1	5.2	4.5	4.0	3.5	3.0	2.5
2.1	1.9	1.65	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5
0.4	0.3	0.2	0.1	0.05	0.0						
0.6	0.6	0.7	0.9	1.0	1.2	1.3	1.7	2.0	2.3	2.9	3.4
4.0	4.6	5.2	5.9	6.5	7.1	7.75	8.2	8.8	9.2	9.5	9.8
10.0	10.2	10.2	10.2	10.15	10.1	10.0	9.8	9.65	9.5	9.3	9.1
8.9	8.7	8.4	8.0	7.2	6.3	5.7	5.0	4.3	3.8	3.4	3.0
2.7	2.4	2.1	1.9	1.75	1.6	1.45	1.3	1.2	1.1	1.05	1.0
1.0	1.0	0.9	0.9	0.8	0.8	0.75	0.75	0.75	0.7	0.65	0.6

206070.25342.0000206070.50302.0001125.80.001 10.0 0.5 0.5 F-05

F- 12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

0.5	0.5	0.8	1.5	2.5	4.5	7.3	10.5	14.1	18.0	20.8	23.1
24.6	25.5	26.0	25.9	25.5	24.9	24.0	23.2	22.4	21.5	20.7	20.0
19.2	18.7	18.0	17.5	17.1	16.8	16.3	16.0	15.7	15.4	15.2	15.0
13.4	11.9	10.5	9.2	8.0	6.9	6.0	5.2	4.5	4.0	3.45	2.9
2.4	2.2	1.9	1.7	1.5	1.3	1.0	1.0	0.9	0.9	0.8	0.8
0.75	0.7	0.7	0.6	0.6	0.55	0.5					
0.6	0.6	0.9	1.1	1.3	1.7	2.1	2.6	3.3	4.2	5.2	6.3
7.5	8.8	10.2	11.4	12.8	14.2	15.4	16.6	17.5	18.3	19.0	19.5
19.7	20.0	20.1	20.1	20.05	19.9	19.7	19.3	18.9	18.5	18.0	17.5
17.0	16.5	16.0	15.5	13.5	11.8	10.2	8.8	7.6	6.6	5.6	4.9
4.25	3.7	3.2	2.8	2.5	2.2	2.0	1.7	1.6	1.4	1.25	1.2
1.1	1.0	0.9	0.85	0.80	0.7	0.6					

207120.25422.0000206070.50372.0001126.00.001 10.0 0.5 0.5 F-06

F-12 PACKED BED HT 7 1/4 IN AIR RATE 2.0 CM SMP LOOP 3 LINE APP 1/6/69

0.0	0.0	1.0	2.5	4.4	7.2	10.8	13.9	17.1	20.0	21.9	23.4
24.3	24.7	24.8	24.5	24.2	23.7	23.0	22.3	21.7	21.0	20.4	19.9
19.3	18.8	18.3	17.9	17.4	17.1	16.8	16.4	16.1	15.9	15.6	15.3
15.1	14.9	14.7	14.4	14.2	14.0	13.8	13.6	12.1	10.5	9.2	8.0
7.0	6.4	5.5	4.9	4.2	3.3	2.7	2.4	2.0	1.8	1.6	1.3
1.1	1.0	0.9	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4
0.4	0.35	0.3	0.3	0.3	0.25	0.25	0.25	0.2	0.1	0.1	0.0
0.5	0.5	1.0	1.1	1.2	1.6	2.0	2.3	3.0	3.8	4.5	5.5
6.6	7.8	9.0	10.1	11.3	12.5	13.6	14.6	15.4	16.2	16.8	17.2
17.5	17.8	17.8	17.8	17.65	17.4	17.2	16.8	16.4	16.0	15.6	15.2
14.8	14.3	13.9	12.1	10.6	9.2	8.0	6.8	5.9	5.1	4.4	3.8
3.3	2.9	2.5	2.2	2.0	1.7	1.5	1.3	1.2	1.1	1.0	0.9
0.8	0.7	0.6	0.55	0.55	0.55	0.5					

206100.25442.0000208070.25522.0001112.80.001 10.0 1.0 1.0 F-07

F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 3 LINE APP 1/7/69

1.3	1.3	2.1	3.6	6.3	10.2	14.4	19.5	23.5	26.9	29.1	30.7
31.4	31.4	31.0	30.2	29.2	28.2	27.1	26.0	24.9	24.0	23.0	22.3
21.4	20.7	20.1	19.6	19.1	18.6	18.1	17.8	17.4	17.0	16.6	16.3
16.0	15.8	15.4	15.2	14.9	14.7	14.4	14.2	14.0	13.8	12.0	10.6
9.2	8.0	7.1	6.3	5.6	4.9	4.3	4.0	3.6	3.1	3.0	2.6
2.45	2.3	2.0	2.0	1.9	1.8	1.6	1.5	1.4	1.3		
0.7	0.7	0.9	1.0	1.1	1.2	1.4	1.6	1.9	2.1	2.5	2.9
3.2	3.7	4.3	5.0	5.5	6.2	6.9	7.6	8.3	9.1	9.9	10.6
11.4	12.1	12.9	13.5	14.0	14.6	15.2	15.6	16.1	16.3	16.7	16.9
17.1	17.2	17.25	17.25	17.25	17.2	17.1	17.0	16.8	16.4	16.0	15.8
15.5	15.2	15.0	14.8	14.5	14.2	12.3	10.7	9.3	8.0	7.0	6.0
5.3	4.6	4.0	3.5	3.0	2.7	2.4	2.1	1.9	1.75	1.6	1.4
1.3	1.25	1.2	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.85	0.85
0.8	0.8	0.8	0.75	0.75	0.75	0.7					

207050.25632.0000206070.50332.0001111.60.001 10.0 1.0 1.0 F-08

F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SHP LOOP 4 LINE APP 1/7/69

0.7	0.7	1.7	4.2	7.3	12.3	17.8	23.0	27.8	32.2	34.7	36.6
37.3	37.3	36.8	35.7	34.7	33.3	32.1	30.8	29.7	28.3	27.2	26.3
25.3	24.6	23.8	23.1	22.5	21.9	21.3	20.9	20.4	20.0	19.65	19.3
19.0	18.6	16.2	14.3	12.3	10.7	9.3	8.1	7.0	6.0	5.2	4.6
4.0	3.4	3.1	2.7	2.3	2.0	1.8	1.6	1.5	1.35	1.2	1.2
1.1	1.05	1.0	1.0	0.9	0.9	0.85	0.8	0.8	0.8	0.8	0.8
0.8	0.8	0.75	0.75	0.7							
0.75	0.75	1.0	1.6	2.3	3.8	5.5	7.7	10.8	14.0	17.9	21.9
25.8	29.3	32.7	35.2	37.2	38.5	39.2	39.3	39.0	38.3	37.3	36.1
34.8	33.4	32.0	30.7	29.4	28.3	27.1	26.0	25.0	24.0	23.0	19.6
16.6	14.2	12.0	10.3	8.8	7.5	6.4	5.5	4.7	4.1	3.6	3.1
2.75	2.4	2.2	2.0	1.8	1.6	1.4	1.3	1.2	1.1	1.05	1.0
0.95	0.9	0.85	0.85	0.8	0.8	0.75					

206120.25392.0000207050.50322.0001111.20.001 10.0 1.0 1.0 F-09

F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SMP LOOP 4 LINE APP 1/7/69

0.6	0.6	1.5	3.5	6.3	11.0	16.5	21.7	26.9	31.6	34.4	36.6
37.5	37.8	37.3	36.3	35.2	34.0	32.7	31.3	30.0	28.9	27.7	25.7
24.9	24.0	23.2	22.6	22.1	21.5	21.1	20.6	20.2	19.9	19.5	19.1
18.8	18.4	18.1	17.9	17.5	15.2	13.2	11.4	9.9	8.5	7.3	6.3
5.5	4.8	4.1	3.6	3.1	2.7	2.3	2.1	1.9	1.8	1.5	1.3
1.2	1.1	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.65	0.6
0.6	0.6	1.0	1.4	2.1	3.3	4.9	7.1	10.0	13.4	17.5	21.9
26.0	30.0	33.8	36.7	38.9	40.3	41.1	41.1	40.7	39.7	38.5	37.1
35.5	34.0	32.3	30.9	29.5	28.1	26.9	25.7	24.6	23.5	19.9	16.8
14.3	12.2	10.4	9.0	7.8	6.7	5.7	5.0	4.2	3.7	3.2	2.8
2.5	2.1	2.0	1.8	1.6	1.4	1.3	1.2	1.1	1.05	1.0	1.0
1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.75	0.75	0.7	0.7
0.7	0.65	0.65	0.65	0.6							

206050.25352.0000206020.50372.0001112.20.001 10.0 1.0 1.0 F-10

F-12 PACKED BED HT 7 1/4 IN AIR RATE 4.0 CM SHP LOOP 3 LINE APP 1/7/69

0.3	0.3	1.4	3.3	6.1	10.2	15.0	19.4	23.8	27.3	29.3	30.6
31.1	31.0	30.4	29.5	28.5	27.3	26.1	25.1	24.0	23.1	22.1	21.4
20.6	19.3	18.8	17.2	16.8	17.3	17.0	16.5	16.2	15.9	15.6	15.2
15.0	13.0	11.2	9.9	8.5	7.1	6.2	5.4	4.7	4.0	3.4	2.9
2.6	2.2	1.9	1.7	1.4	1.3	1.2	1.0	1.0	0.9	0.75	0.75
0.7	0.6	0.5	0.4	0.3							
1.1	1.1	1.2	1.5	1.8	2.3	3.0	4.0	5.2	6.5	8.1	9.9
11.6	13.3	15.2	16.7	17.0	19.2	20.1	20.7	21.0	21.0	20.9	20.6
20.1	19.6	19.0	18.3	17.8	17.1	16.4	15.9	15.2	14.8	14.2	13.7
13.2	12.8	12.2	10.6	9.2	8.0	7.0	6.1	5.2	4.7	4.1	3.6
3.2	2.9	2.6	2.3	2.2	2.0	1.8	1.7	1.6	1.5	1.4	1.3
1.2	1.1										

205110.25282.0000205080.50142.000110.700.001 10.0 0.5 0.5 F-11

F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 5 LINE APP 1/9/69

1.0	1.0	2.0	4.0	6.8	10.8	15.1	19.2	23.0	26.1	27.9	29.0
29.2	28.9	28.0	27.0	26.0	24.9	23.8	22.8	21.9	20.9	20.0	19.3
18.8	18.2	17.6	17.1	16.8	16.2	13.9	12.1	10.6	9.2	8.0	7.0
6.1	5.3	4.7	4.1	3.5	3.1	3.0	2.6	2.4	2.2	2.0	2.0
1.7	1.6	1.5	1.4	1.4	1.2	1.2	1.1	1.1	1.05	1.0	
0.0	0.0	0.5	1.4	2.7	4.5	6.4	8.2	9.4	9.9	9.7	9.3
8.9	8.5	8.1	7.8	7.0	6.6	6.8	7.2	7.2	7.0	7.1	7.5
7.3	6.9	7.0	6.8	6.0	5.2	4.8	4.2	4.0	3.5	3.0	2.6
2.3	2.0	1.8	1.5	1.3	1.2	1.0	0.95	0.8	0.6	0.5	0.4
0.4	0.3	0.25	0.2	0.2	0.1	0.05	0.0				

205070.25272.0000205070.50172.000110.600.001 10.0 1.0 1.0 F-12

F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SHP LOOP 4 LINE APP 1/9/69

1.0	1.0	2.2	4.3	7.3	11.8	16.8	21.4	26.0	30.3	32.7	34.0
34.1	33.8	33.0	32.0	31.0	29.9	28.3	27.3	26.0	24.9	23.8	23.0
22.1	21.4	20.7	20.2	19.5	16.0	14.1	12.2	10.8	9.3	8.3	7.1
6.2	5.3	4.6	4.3	3.6	3.3	3.0	2.4	2.4	2.1	2.0	1.9
1.9	1.7	1.6	1.3	1.2	1.1	1.0					
-0.1	-0.1	0.2	1.2	2.5	3.2	6.2	8.0	9.8	10.9	11.2	11.0
10.5	10.2	9.3	8.9	8.4	8.1	7.8	7.0	6.8	7.0	7.2	7.3
7.3	7.8	7.8	7.6	8.0	7.5	6.4	5.8	5.3	5.0	4.3	3.7
3.2	2.7	2.2	1.9	1.7	1.3	1.0	0.9	0.8	0.6	0.4	0.3
0.2	0.1	0.0	0.0	0.0	-0.05	-0.1					

205080.25262.0000205070.50192.000110.600.001 10.0 1.0 1.0 F-13

F-12 FLUIDIZED BED HT 7 1/4 IN AIR RATE 5.0 CM SMP LOOP 4 LINE APP 1/9/69

1.0	1.0	2.6	4.9	8.1	13.2	18.5	23.1	27.2	30.9	32.6	33.5
33.6	33.3	32.4	31.2	30.1	29.0	27.5	26.2	25.2	24.1	23.2	22.5
21.6	21.0	20.1	19.7	16.6	14.1	12.5	11.0	9.8	8.2	7.2	6.2
5.2	4.9	4.1	3.8	3.5	2.8	2.6	2.4	2.1	1.9	1.9	1.8
1.6	1.5	1.4	1.3	1.2	1.1	1.05	1.0				
0.0	0.0	1.2	2.9	4.9	7.5	10.0	12.0	13.7	14.5	14.7	14.1
13.4	12.8	12.1	11.6	11.1	10.8	10.3	10.0	9.2	8.7	8.4	8.7
8.6	8.5	8.4	9.2	9.8	8.6	7.6	6.8	6.1	5.5	4.9	4.2
3.9	3.4	3.0	2.5	2.2	1.8	1.5	1.2	1.0	0.9	0.75	0.5
0.4	0.3	0.25	0.2	0.1	0.05	0.0					

205090.25282.0000205110.50172.000110.450.001 10.0 0.5 0.5 F-14

F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 5 LINE APP 1/22/69

1.5	1.5	2.8	4.9	7.7	11.7	15.8	19.2	22.2	24.4	25.5	25.9
25.8	25.2	24.3	23.2	22.2	21.2	20.2	19.3	18.5	17.8	17.1	16.6
16.0	15.6	15.1	14.9	14.5	14.2	12.3	10.7	9.4	8.3	7.5	6.5
5.9	5.2	4.6	4.1	3.8	3.4	3.1	2.8	2.6	2.4	2.2	2.1
2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.6	1.5			
0.7	0.7	2.0	4.2	6.8	8.8	10.1	11.0	11.6	12.0	12.1	12.0
11.8	11.6	11.3	11.0	10.8	10.6	9.5	9.0	8.8	8.6	8.4	8.0
7.8	7.2	6.7	6.0	5.7	5.3	5.1	4.4	4.0	3.8	3.6	3.2
2.8	2.6	2.4	2.2	2.0	1.9	1.8	1.7	1.5	1.4	1.3	1.25
1.2	1.1	1.0	1.0	1.0	0.9	0.9	0.8	0.8	0.75	0.7	

205070.25302.0000205050.50162.000110.600.001 10.0 1.0 1.0 F-16

F-12 FLUIDIZED BED HT 7 3/8 IN AIR RATE 6.0 CM SMP LOOP 4 LINE APP 1/22/69

1.0	1.0	2.2	4.3	7.6	12.0	16.9	21.2	25.0	28.1	29.7	30.2
30.1	29.6	28.6	27.3	26.3	25.1	24.0	23.0	21.9	20.8	20.0	19.3
18.8	18.2	17.7	17.3	16.9	16.4	15.9	15.5	13.4	11.7	10.0	8.8
7.8	6.9	5.8	5.1	4.4	4.0	3.4	3.0	2.8	2.3	2.1	1.9
1.8	1.8	1.4	1.3	1.2	1.1	1.05	1.0				
1.0	1.0	1.5	2.5	4.2	6.3	8.0	9.1	10.2	11.5	12.6	13.0
13.0	12.6	12.0	11.6	11.2	11.0	10.4	10.1	9.9	10.0	9.8	9.1
8.5	8.2	7.4	6.8	6.2	5.5	5.0	4.5	4.3	4.1	3.8	3.3
3.0	2.7	2.5	2.3	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.35
1.3	1.2	1.1	1.05	1.0							

204120.25242.0000205030.50122.000111.100.001 10.0 1.0 1.0 F-18

F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 4 LINE APP 1/22/69

2.0	2.0	2.5	3.6	5.2	7.7	10.1	12.8	15.2	17.8	19.5	20.7
21.4	21.6	21.5	21.1	20.6	20.0	19.2	18.5	17.8	17.0	16.3	15.9
15.3	14.9	12.3	10.8	9.6	8.4	7.4	6.4	5.7	5.1	4.6	4.1
3.9	3.4	3.0	2.8	2.6	2.3	2.3	2.2	2.1	2.1	2.05	2.0
0.1	0.1	1.5	3.1	5.1	7.2	8.5	9.5	10.0	10.1	9.9	9.6
9.2	9.0	9.0	9.1	9.0	9.0	8.3	7.7	7.2	6.6	6.0	5.3
4.9	4.2	3.9	3.3	3.0	2.7	2.3	2.0	1.8	1.7	1.5	1.3
1.1	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.15
0.15	0.15	0.1									

206040.25302.0000207040.50272.000110.700.001 10.0 1.0 1.0 F-20

F-12 FLUIDIZED BED HT 7 5/8 IN AIR RATE 8.0 CM SMP LOOP 5 LINE APP 1/22/69

1.1	1.1	2.0	3.0	4.1	6.5	9.8	13.1	17.8	22.8	26.8	30.5
33.2	35.5	37.0	37.9	37.9	37.4	36.6	35.5	34.1	32.8	31.4	30.2
29.0	28.0	26.8	25.9	25.1	24.4	23.8	23.0	19.5	16.8	14.5	12.6
10.7	9.3	8.2	7.1	6.2	5.5	5.0	4.2	4.0	3.6	3.2	3.0
2.8	2.6	2.3	2.1	2.0	2.0	1.8	1.8	1.7	1.6	1.5	1.4
1.3	1.2	1.15	1.1								
0.1	0.1	2.0	4.2	6.4	8.8	10.9	13.0	15.0	16.1	16.7	16.6
16.2	15.9	15.5	15.2	15.0	14.9	15.0	15.0	15.2	15.6	15.8	16.0
16.2	16.4	16.6	16.5	16.2	15.1	14.1	13.2	12.1	11.2	10.0	9.0
8.1	7.3	6.4	5.8	5.0	4.5	4.0	3.4	3.0	2.8	2.5	2.1
1.9	1.8	1.6	1.2	1.1	1.05	1.0	1.0	0.9	0.8	0.7	0.7
0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.4	0.3	0.2
0.2	0.2	0.15	0.1								

VITA

William Charles Zalewski was born in ,
, in . He received his B.S.Ch.E. from Newark College of Engineering in 1963. Upon graduation, he was the recipient of a Menninger Fellowship at the University of Virginia. He received the M.Ch.E. in 1965.

He was employed by the Chevron Oil Company from 1964 to 1967. In 1967, he was awarded a teaching fellowship and pursued his doctoral program full time at Newark College of Engineering. In the fall of 1967, he was awarded a N.D.E.A. Title IV Fellowship.

He is a member of Omega Chi Epsilon. He is married and has one daughter.

Presently he is employed by the Insulating Department, General Electric Company in Schenectady, New York.