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NRL Memorandum Report 1565

DESIGN OF A PLANE-WAVE, NEAR-FIELD CALIBRATION ARRAY

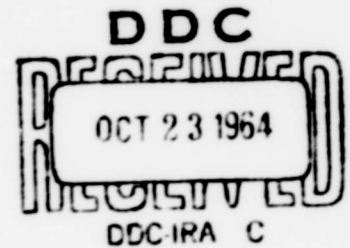
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SOUND DIVISION

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ABSTRACT

The design and construction of a near-field hydrophone array for calibration of underwater transducers initiated by Trott (1) is reviewed in detail. Considering the recommended procedures the authors propose to build a near-field array to test a transducer having the dimensions of a 17 ft cube, at a frequency of 3 kc. The desired far-field pattern of the proposed array is given by the formula $(\sin m \varphi / m \sin \varphi)^n \cos^n \varphi$, where the parameters m , n must be selected to insure an adequate effective width, i. e., spatial volume in front of the array. In a first choice the selection was $m = 29$, $n = 21$, resulting in a $40 \times 40 = 1600$ element array with modified binomial shading, spaced 0.8λ center to center, λ corresponding to the upper limit frequency at 6 kc. Extensive near-field calculations were then made by assuming the elements to be point sources, and neglecting interaction radiation impedance effects. These calculations showed that the effective width was 14 ft maximum, which was too small for the specified maximum size transducer. A second choice led to the selection $m = 36$, $n = 26$, resulting in a $50 \times 50 = 2500$ element array. Extensive computations of the near field on an IBM 7090 computer were once more undertaken covering the frequencies of 1, 3, 6, 9, and 12 kc, and distances from 10 inches to 25 ft from the face of the array. Graphs of pressure amplitude and phase based on these computations show that an effective width of approximately 17 ft is available from 1 kc to 6 kc, at distances of 10 inches to 25 ft from the face of the array. Over this volume and over this frequency the wave field is computed to be essentially planar. Beyond 6 kc the array will apparently not form a planar near field. From these results and from additional study it is concluded that the choice $m = 36$, $n = 26$ is acceptable.

PROBLEM AUTHORIZATION

SF 001-03-18-8047 RF 101-03-44-4052 RF 101-03-45-5256
NRL Problem 55S02-12 NRL Problem 55S02-07 NRL Problem 55S01-24

PROBLEM STATUS

This is an interim report on one phase of the project.
Work is continuing.

INTRODUCTION

The calibration and evaluation of large sonar transducers, including the effects of their associated domes, at the Naval Research Laboratory Transducer Calibration Platform located on Lake Seneca in New York requires that near-field measurements be employed. An illustration is the BQS-6 transducer which with its associated dome may be considered to occupy a volume enclosed by a parallelepiped 17 feet by 17 feet by 15 feet. If a far-field calibration of this transducer-dome complex were undertaken, the distance to the nearest calibrating hydrophone should not be less than D^2/λ , see ref. (5), where D is the diameter and λ the wavelength at the frequency in question. Therefore, the separation distance is given by $(17)^2/(2)$, or 347 feet at 6 kc and not less than 173 feet at 3 kc. These test distances are in excess of the barge length, which is 150 feet, and therefore make near-field measurements a real necessity. In addition, the above distances are marginal since the first side lobe will not be properly formed unless the test distance is much larger than D^2/λ .

Several near-field measurement methods have been proposed and investigated in the past few years. The procedure which uses a specially shaded receiving array has both versatility and minimum test station personnel requirements to recommend it and has therefore been selected as the initial approach to near-field measurements at NRLTCP, Lake Seneca.

The near-field testing of underwater sound transducers by means of such specially designed receivers has been investigated by Trott (1) with success. The Transducer Branch of the Sound Division, NRL proposes to build a large receiver of the Trott type of sufficient size and frequency range to permit testing of a full-size BQS-6 transducer array with associated dome. To this end a set of design notes is appended below to show the reasoning followed in our selection of appropriate electronic and mechanical structures.

A. Design Notes

I. The "Gaussian Emitter"

The first objective in the design of a Trott-type receiver is to select an amplitude distribution over its face such as to permit it to generate approximate plane waves in its near field. We set our goal then to this: the near field is to be free of criss-crossing waves and their associated interference patterns. Experiment and theory (2) show that freedom from interference patterns in the near field is equivalent to absence of side-lobes in the far field. We are thus lead to consider first an amplitude distribution of Gaussian type over the surface of a radiating circular "membrane" in an infinite rigid plane, a distribution known to inhibit the formation of side lobes in the far field (2). Let the membrane radius be R , and the Gaussian shading function (normalized to unity) be $e^{-\rho^2/R_0^2}$, in which R_0 is the radius having a shading of e^{-1} or 0.37 and ρ = radial coordinate. The characteristic near-field parameter for a rigid piston emitter of area S , at wavelength λ is S/λ (2) and the range D_0 of the near field being determined by the requirement $D_0 < \frac{S}{\lambda}$. For the "Gaussian emitter" the near-field parameter is taken (2) as R_0^2/λ . If the symbol a is the distance along the axis of the circular membrane with origin at the center of the membrane, mathematical derivation of the sound pressure p_a of the Gaussian emitter on the axis leads to the formula

$$\frac{p_a}{p_0} = \frac{1}{\sqrt{\frac{a\lambda}{\pi R_0^2} + 1}}$$

A convenient distance parameter for this type of emitter is thus $A = a/(R_0^2/\lambda)$. Reference (2) compares the relative axial sound pressure vs A for a Gaussian emitter ($R = 2R_0$) and a rigid piston ($R = R_0$), a reproduction of which is sketched in figure 4a).

From this sketch we may reasonably conclude that Gaussian emitters "homogenize" or produce rather constant pressures in the near field, at least along the axis of the emitter. But this is not sufficient for our purposes. We must also examine the off-axial near field. In reference (2) we find an elaborate experiment for measurement of the near field of a Gaussian emitter at off-axial, as well as axial, positions. A sketch of experimental results is shown in figure (b). The results of this experiment lead to the conclusion that Gaussian emitters are unacceptable for near-field testing because of poor off-axial pressure homogeneity.

II. The $\text{Cos}^n (\pi x/B)$ Emitter

Linhardt (3) discovered experimentally that rectangular membranes shaded according to the distribution function $\text{Cos}^n \frac{\pi x}{B}$, x/B being the ratio of distance from center to total membrane width, also tends to homogenize the near field. Now the distribution $\text{Cos}^n (\frac{\pi x}{B})$ over a rectangular membrane generates a far-field pattern $R(\xi)$ sketched in figure (c). In figure (c), α is the direction angle measured from the axis. It is immediately apparent that the condition of no side lobes corresponds to n large. However, for n large the function $\text{cos}^n \phi$ vs ϕ diminishes very rapidly from unity at $\phi = 0$ to zero at $\phi = \pi/2$. The distribution function $\text{cos}^n \phi$ ($n \gg 3$) is thus similar to the Gaussian function $e^{-\rho^2/R_0^2}$. Hence we conclude that "cosⁿ($\pi x/B$) emitters", though they homogenize the near field on the axis, generate reduced and variable fields off axis. Hence "cosⁿ ($\frac{\pi x}{B}$) emitters" are unacceptable for near-field testing for the same reasons as applied to the Gaussian emitter in section I above.

III. Trott Shaded Emitter

A line array of $n + 1$ elements shaded according to the expansion coefficients of the binomial expansion will generate a far-field pattern of the type $\text{cos}^n \phi$, where $\phi = \frac{\pi d}{\lambda} \sin \gamma$, d is element spacing and γ is direction angle. Such a pattern exhibits no side lobes, and hence corresponds to a homogenized near field, on axis. As before, the off-axis field is unacceptable for near-field testing. Trott (1) modified the line binomial shading so as to introduce side lobes in the far-field pattern, thereby attempting to homogenize the off-axis field as well. He strove to find a pattern given by the characteristic

$$R = \frac{\sin m\varphi}{m \sin \varphi} \cos^n \varphi$$

With proper choice of m , n the near field will not only be homogenized on axis, but off-axis as well. Calculation shows that if n is large and m small, the axial field is good but the off-axial field poor. If m is large and n is small the off-axial field is excessively variable in magnitude and phase over any parallel plane in the near field. Hence the general (empirical) requirement that n and m should not differ greatly.

When m and n are properly selected the resulting line array can be used as the basic line in a planar array by means of the beam pattern multiplication theorem. Trott's procedure as outlined in (1) is then this: (1) find the appropriate line array, i. e., the correct m and n for the job; (2) construct the plane array by use of the Product Theorem. We shall apply Trott's procedures and design a plane-wave array for testing large transducers of the type mentioned before.

B. NRL Array Design

I. Overall Dimensions and Element Spacing

All previous experience (1) with these arrays have shown that the "effective width" of the array, namely, that width over which the plane wave near-field goals are fulfilled, is in excess of $1/2$ of the actual physical dimensions. If we desire to test a transducer of over all 17 ft dimension (i. e., the dimension to good approximation of the BQS-6 transducer-dome complex), we guess that the total dimensions of the array should be at least 36 ft x 36 ft. Over this length we set the individual elements at such a spacing d that the ratio d/λ is less than 0.8. The reason for this number will be explained later. Now the upper frequency of interest is 6 KC, which corresponds to a wavelength of 10 inches. Hence we allow d to be 8 inches. In a single line of the total array we thus should have $36 \times 12/8 \approx 54$ elements, a somewhat large figure. Since m and n should not differ much from each other we could set $m = n = 25$, say. However, calculations corresponding to this

selection of parameters show that a number of coefficients will have effectively values of zero, especially along the outer edges of the array. We therefore arbitrarily make the nominal total on one line to be 50 elements, $m = 29$, $n = 21$. The actual total will be less for a complete line because a few elements will have effectively zero shading, but we shall reject these edge elements only after the calculations with these parameters are made.

For initial orientation we have calculated and plotted the far-field patterns based on the formula and ranges,

$$R = \frac{\sin m \varphi}{m \sin \varphi} \cos^{2l} \varphi, \quad m = 11, 13, \dots 31$$

These plots appear in Figs. 1e, 1f. We have also marked on these plots the position and magnitude of the peak of the first minor lobe for the condition $n = 0$, $m = 50$. A similar plot for $n = 25$ is shown in Fig. 2.

II. Effective Width, Frequency Range of Usefulness, Plots of Normalized Pressure at Center of Array vs Frequency

For convenience we assume that $n + m$ as well as $m - n$ are even integers. We direct our attention to the design of the appropriate line array, and note first that it is symmetrical with respect to the center line of the array. These stipulations imply that the first piezoceramic array element is at a distance of $d/2$ from the center line. Each succeeding element is at a spacing d from its neighbor (see figure 1d)).

We imagine now that each ceramic element is effective over a distance $\pm d/2$ from its position, and that rotation of the (shaded) area of effectiveness about the center line of the array generates a ring transducer of average radius R_1 , width d , and source strength (= shading) w_1 . Now according to Stenzel (4) the pressure p' at the center of this imaginary ring in the plane of the ring is

$$p' = 2 w_1 \sin \frac{kd}{2} \left[\cos \left(\omega t + \frac{\pi}{2} - kR_1 \right) + j \sin \left(\omega t + \frac{\pi}{2} - kR_1 \right) \right]$$

If we omit the time factor $e^{j\omega t}$ and write $j = e^{j\pi/2}$, we see that

$$\frac{p'}{2} = w_1 \sin \frac{kd}{2} \left[\sin kR_1 + j \cos kR_1 \right]$$

The total pressure p then due to $\left(\frac{m+n}{2}\right)$ imaginary transducer rings is therefore

$$p = \sum_{i=1}^{\frac{m+n}{2}} w_1 \sin \frac{kd}{2} \left[\sin kR_1 + j \cos kR_1 \right]$$

in which $R_1 = (2i - 1)d/2$. By assuming values of d/λ one can plot p vs d/λ to find the frequency range over which the pressure at the center of the planar array will be constant. This range is a good estimate of the frequency span of the final array which will produce a roughly constant volume plane wave core. A representative plot of $|p|$ vs d/λ is shown in Fig. 3.

An examination of these plots leads to the following convenient (empirical) rule concerning frequency range of usefulness: the parameter d/λ has an upper limit of permissible value at approximately 0.8, and a lower limit of permissible value at approximately 0.2. This holds for most choices of parameters m, n . The array is, however, usable at lower and higher frequencies at the cost of a reduced plane wave core volume.

III. Shading Coefficients

As noted above the first step in Trott's design procedure is to find the shading coefficients of the primitive line array. The basic shading is binomial, because we desire a partial suppression of the side lobes. In this respect the parameter n determines the value of the shading coefficients in accordance with the following scheme of Stenzel (4),

$$\mathcal{C}_2^n = [1, \binom{n}{1}, \binom{n}{2}, \dots, \binom{n}{n}]$$

where

$$\binom{n}{x} = \frac{n!}{x!(n-x)!}$$

Example: $n = 3$

$$\mathcal{C}_2^3 = 1, 3, 3, 1 \quad .$$

The basic binomial shading must be modified to improve the off-axial field. Following Trott's methods, we use the parameter m as a replication factor. If $m = 3$, in the above example the primitive line array is increased from 4 to 6 elements, and the new (improved) shading of the array is,

$$\begin{array}{cccc} 1 & 3 & 3 & 1 \\ & 1 & 3 & 3 & 1 \\ & & 1 & 3 & 3 & 1 \\ \hline 1, & 4, & 7, & 7, & 4, & 1 \end{array}$$

For the choice of parameter $m = 29$ and $n = 21$, the replication procedure leads to the following Table of Shading Coefficients for the primitive line array. Note that the coefficients are normalized to unity and that only one-half of the total number are listed since the line array is symmetrical about the center line. The first coefficient corresponds to the first element to the left of the center line, and each succeeding coefficient corresponds to the succeeding elements in the line.

Table

1.0000, 1.0000, 1.0000, 1.0000, 0.9999, 0.9999, 0.9998,
 0.9992, 0.9964, 0.9867, 0.9608, 0.9054, 0.8083, 0.6682,
 0.5000, 0.3318, 0.1917, 0.09462, 0.03918, 0.01330.

We have omitted the coefficients of the last 5 elements toward the edge because these are very minute.

A special significance is attached to the distance R_0 from the center line of the primitive array to the element having a normalized shading coefficient of value 0.5. This R_0 defines, in the opinion of Trott (1), the radius of the effective width of the plane array. For parameters $m = 29$, $n = 21$ we see that $R_0 = \frac{29d}{2}$. Since $d = 8$ inches (at 6 kc), we estimate the effective width at 6 kc of the final plane array to be $2(29 \times 8/2) = 232$ inches or $19\text{-}1/3$ ft. The parameter R_0 may be used to estimate the lower frequency limit of usefulness. We allow $d/2$ to be $R_0/29$, and plot the pressure at the array center vs R_0/λ . In a single computation for the selection $m = 9$, $n = 5$ Trott found that $R_0/\lambda \sim 1.2$ constituted the lower limit of usefulness of the array. If we accept this figure for R_0/λ we see that for $d = 8$ ", $R_0 = 116$ in, and $\lambda = 116/1.2$ or $96\text{-}2/3$ inches. This is equivalent to ~ 620 cps. Since d/λ has an upper limit of 0.8, and (in the case of $m = 29$, $n = 21$) a lower limit of $2/29 \approx 0.07$, the ratio of upper to lower limits (in frequency) is estimated to be $0.8/0.07$ or 11. If we do not accept $R_0/\lambda \sim 1.2$ as the proper lower limit we must make a plot of p vs R_0/λ . This plot is not available to date, but will appear in our final design.

Again in accordance with Trott (1) the axial depth of constant sound pressure is R_0^2/λ . At 6 kc this figure amounts to $(116^2/8$ in) or 140 ft.

IV. Planar Shading Coefficients

The primitive line array lends itself to the construction of a plane array by means of the product theorem. We select, as with Trott (1), two possible plane symmetries (1) Circular Symmetry, (2) Square Symmetry. Let the shading coefficients of the primitive array tabulated above be labelled a, b, c etc. in order, left to right. Then circular and square symmetrical arrays may be constructed from the primitive array by the scheme shown in the sketches of one quadrant of each array below:

	ac	bc	cc	dc
	ab	bb	cd	db
	aa	ba	ca	da
0	Circular Symmetry			

	e'	e'	e'	e'	e'
	d'	d'	d'	d'	e'
	c'	c'	c'	d'	e'
	b'	b'	c'	d'	e'
	a'	b'	c'	d'	e'
0	Square Symmetry				

Here, ac means a x c. Also the primed symbols are related to the unprimed symbols by the relation, $5 e' = e$, $4d' + e = d$, etc.

For the present report the case of circular symmetry has been extensively studied, leaving the case of square symmetry for later investigation. Computation results of planar arrays designed for circular symmetry on the basis of the primitive array $m = 29$, $n = 21$ are presented and discussed below.

V. Field Calculations on Proposed Array

Let $p(x, y, z)$ be the pressure in arbitrary units at some point in the field to one side of the proposed Trott array. We assume that each element in the array is a point source of sound, and that interactions between elements are negligible. Each element, subscript j , contributes to p . Thus

$$p(x, y, z) \approx \sum_j w_j e^{ik \delta_j} \left[\frac{e^{ikr_j}}{r_j} \right]$$

Here, w_j the shading coefficient of the j th element, $k \delta_j$ is a possible phase angle of the shading coefficient (here assumed zero), r_j is the distance between the j th element in the plane and the field point, and $k = 2\pi/\lambda$. We proceed by constructing a set of circular symmetry shading coefficients using the coefficients of the primitive array tabulated above, as explained in the previous section. Although a total of 50×50 elements is called for ($m + n = 50$) by the formulas, we shall reject, in the experimental array all shading coefficients of the primitive array with value less than 0.01. This rejection leads to a tentative array 40×40 in size. Further, since the computation of 400 separate points is very tedious, it will be enough for our purpose here to calculate the pressure (phase and magnitude) on any particular plane, $Z = h$, only along the X-direction in the plane (called "vertical" here) and along the 45° diagonal in the plane (called "diagonal" here). We have selected the following planes, $z = \text{const.}$, for investigation: $z = h = \lambda, 2\lambda, 10\lambda, 20\lambda, 30\lambda$, and have plotted magnitude $|p|$ (in arbitrary units) and phase (degrees) vs (relative) element position from zero at the edge of the array to 19.5 at the center of the array. These plots appear in Figs. 4A to 4I.

To interpret the plots we will need a good criterion of the concept "plane wave". For purposes confined to the present application, we shall consider a "plane wave" to coincide in spatial extent with a wave front of constant phase, and to progress in the direction of travel from plane Z_1 to plane Z_2 with a phase change $e^{ik(z_2 - z_1)}$. Further, since we desire a 'plane wave' over a region at least 17 ft in diameter,

we see that at 6 kc the plane wave region must extend from the center line out to relative position 6. With this in mind we examine the plotted field at $h = \lambda$ in Figs. 4A, 4B. This plot shows that a plane wave has been achieved out to 18 ft. The pressure magnitude is constant within 1-1/2 db only out to 16-2/3 ft. At $h = 2\lambda$, the plotted field in Figs. 4C, 4D show little change from conditions at $h = \lambda$. At $h = 10\lambda$ Figs. 4E, 4F the plane wave extends over 18 ft, with an error of 2 degrees along the "vertical", and an error of 7 degrees along the diagonal. Once more the pressure is constant within 1-1/2 db over 16-2/3 ft. At $h = 20\lambda$, Figs. 4G, 4H, the error in the plane wave phase over the 18 ft on the diagonal is 13° . The pressure is constant to within 1-1/2 db over approximately 14 ft. At $h = 30\lambda$, Figs. 4I, 4J the plane wave extends over 18 ft with an error in phase of 8 degrees. The pressure is constant to within 1-1/2 db over approximately 15 ft.

These results are promising and show that the choice $m = 29$, $n = 21$ is in the correct range. It will be instructive to check the effects of shading by making one calculation with uniform excitation on all contributing sources. We have made this calculation at $h = 10\lambda$, and plotted the results in Figs. 5A, 5B. The strong pressure and phase fluctuations are immediately evident in this last case, and demonstrate the advantages of adequate shading for the purposes at hand. We note however that the peak pressures for uniform excitation are considerably higher than for Trott-type shading. If the proposed array were a power source we would expect greater power from uniformly excited elements than from shaded elements.

Conclusions: Our tentative choice of parameters lead to an array of $40 \times 40 = 1600$ elements, or approximately 26 ft x 26 ft actual size. The design falls somewhat short of our ultimate goals, and we shall consider in the next section a further exploration to improve the pressure distribution at distances of 10λ to 30λ from the plane of the array. To this end, we have devised a Fortran Program suitable for use on the IBM 7094 computer, with the object of varying the parameters m and n so as to improve the effective width of the array.

VI. Improved Design

The availability of the Fortran Program mentioned above gave us hope that we could improve the effective width of the receiver array by an overall increase in size. We then selected $m = 36$, $n = 26$ and formed an array with circular symmetry. Some of the shading coefficients at the edge of the array were effectively zero. We judged that a deletion of 5 outside rings would not affect the results. Our tentative choice then was a 50 x 50 array, with element spacing of 8" making an overall size of approximately 34 ft x 34 ft.

The results of our calculations of amplitude and phase of pressure at a frequency of 3 kc are shown in Figs. 6A, 6B respectively. Our survey ranged from a height of $1/2\lambda$ to 15λ above the surface of the array in 7 steps ($1/2\lambda$, 1λ , 2.5λ , 5λ , 7.5λ , 10λ , 15λ). Our first concern is effective width. We see from Fig. 6A that the effective width at 3 kc as determined by the amplitude of $\pm 1/2$ db variation of pressure at the highest surveyed level (750 cm or 25 ft) is approximately 17 ft. At a height of $1/2\lambda$ (that is, 10") the effective width is approximately 18-1/2 ft. From 10" to 25 ft above the array the effective width is 17 ft or better. This satisfies our requirements, at least with respect to pressure. With respect to phase our design is somewhat less satisfactory. We examine Fig. 6B and note that for transverse planes of survey near the array, from $1/2\lambda$ to 5λ , the phase is constant within 3° over an effective width of 18 ft. At $7-1/2\lambda$, the phase error is 5° , at 10λ the phase error is 8° and at 15λ the error is 10° , all over an 18 ft effective width. These phase errors are acceptable within the framework of our initial assumptions regarding this array. The tentative design is therefore acceptable (in an overall sense) at 3 kc.

When a similar investigation was made at a frequency of 6 kc a surprisingly better performance was obtained. The element spacing ($= d$) for this design is 8", which at a frequency of 6 kc is 0.8λ . From Trott (1) this value for spacing is the recommended one. Fig. 7A shows the relative pressure amplitudes at distances in front of the array from 1λ to 30λ . We see that an effective width of 18 ft is easily achieved within this range. The required maximum depth of effective plane wave core is 17 ft, or $\sim 18\lambda$. Hence at 6 kc the proposed design satisfies all requirements of pressure uniformity.

With regard to phase uniformity a similar remark can be substantiated by examining the phase plots of Fig. 7B. Here the uniformity of phase at the various distances from the array implies the existence of an effective plane wave up to and beyond the necessary region. The design requirements are therefore satisfied at 6 kc.

We next explored the calculated performance at a frequency of 1 kc. The relative pressure amplitudes at various distances for this frequency are shown in Fig. 8A. Examination of this chart shows that performance has deteriorated. We require an effective width of 17 ft up to distances of about $3-2/3\lambda$ or 550 cm from the plane of the array. The calculated effective width is 18 ft up to 250 cm (or 2λ), but drops to 14 ft at 500 cm (or $3-1/3\lambda$). If we relax our (arbitrary) definition of effective width so that $\pm 1-1/2$ db of pressure variation is permitted we see that the new effective width is about 17 ft. From the point of view of pressure uniformity the proposed design is marginal at 1 kc, but still acceptable. The variations of phase from the ideal phase-distance relations in plane waves are shown in Fig. 8B. Here, at 500 cm ($3-1/3\lambda$) there is a maximum phase error of about 12° when compared with the mean at nearer distances. This too is a marginal performance, but we shall accept it.

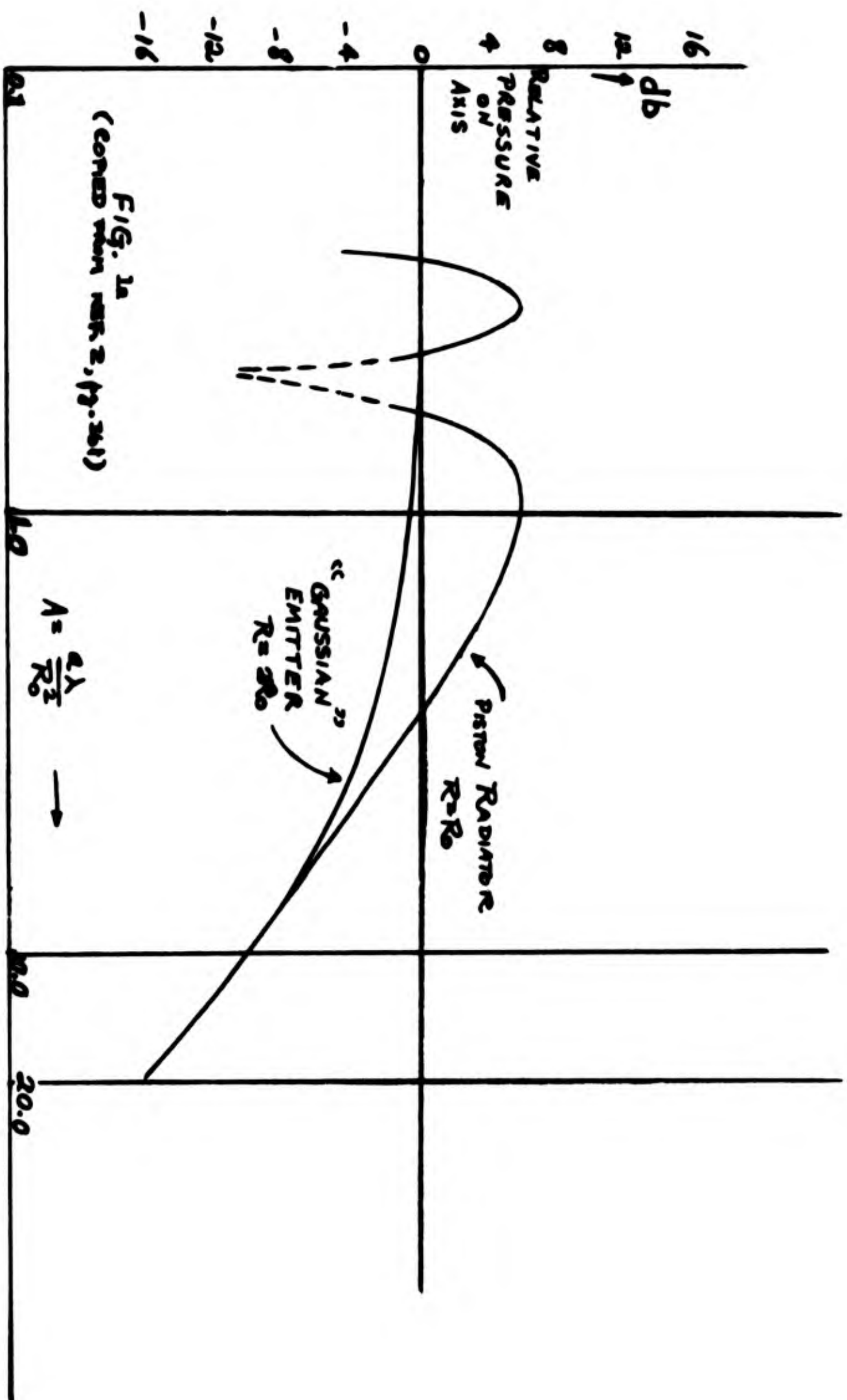
Calculated performances at two other frequencies (9 kc, 12 kc) were also studied. The results at 9 kc are shown in Figs. 9A, 9B. Examination of these graphs shows that an effective right cylindrical volume of plane wave character, such as appeared in the 1 to 6 kc region is no longer in existence for the calculated regions. Instead, we see in Fig 9A the rudiments of 3 plane wave regions, whose use for near-field testing is problematical. Even greater deterioration is shown in Figs. 10A, 10B, which present the data for 12 kc. We conclude from these last four graphs, and from previous results at the lower frequencies that the proposed design is limited in its use for near-field testing by an upper and lower frequency beyond which the calculated performance is apparently unacceptable. For our design the frequency limits are 1 kc at the lower end to approximately 6 kc at the upper end, when the BQS-6 transducer-dome combination is the test object. The array is usable for lower frequencies for test objects having a reduced plane wave volume requirement compared to the BQS-6.

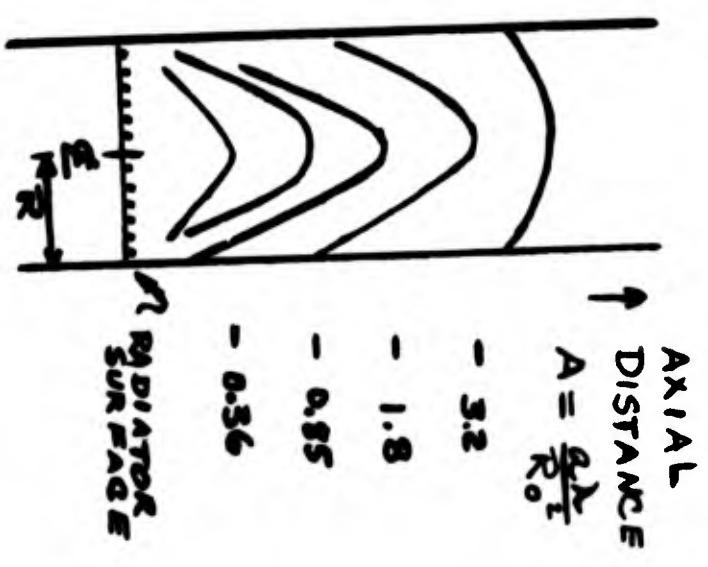
VII. Tables of Calculated Performance

All the graphs presented in Figs. 6A to 10B are for calculated performance in one plane only (namely the XZ plane, Z being the direction perpendicular to the plane of the array). Data for all other planes containing the Z-axis are also available. We list below sets of tables from which additional performances may be calculated.

Table No.	Frequency	Type of Data
1A	1 Kc	Pressure
1B	1 Kc	Phase
2A	3 Kc	Pressure
2B	3 Kc	Phase
3A	6 Kc	Pressure
3B	6 Kc	Phase
4A	9 Kc	Pressure
4B	9 Kc	Phase
5A	12 Kc	Pressure
5B	12 Kc	Phase

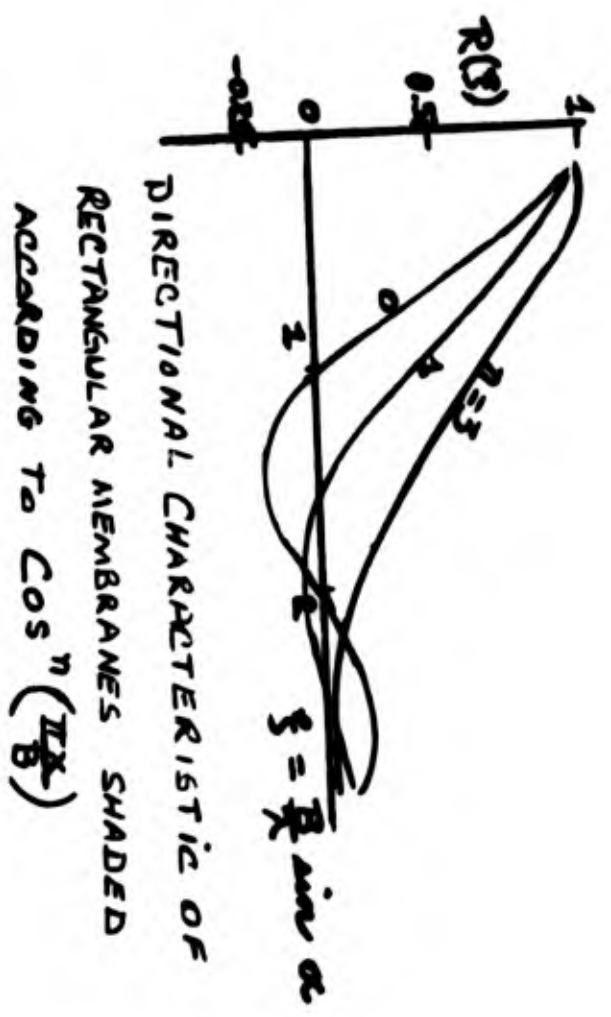
VIII. This work was supported in part by the Office of Naval Research, Code 468, RF 001-03-05 (Special).





SOUND PRESSURE ON
 AXIS AND IN PLANES
 PERPENDICULAR TO AXIS,
 MEASURED ON A
 QUASI-GAUSSIAN EMITTER

FIG. 1b
 (CORIED FROM REF. 2 PG. 362)



DIRECTIONAL CHARACTERISTIC OF
 RECTANGULAR MEMBRANES SHADED
 ACCORDING TO $\cos^n \left(\frac{\pi x}{b} \right)$

FIG. 1a.
 (CORIED FROM REF. 3, PG. 1090)

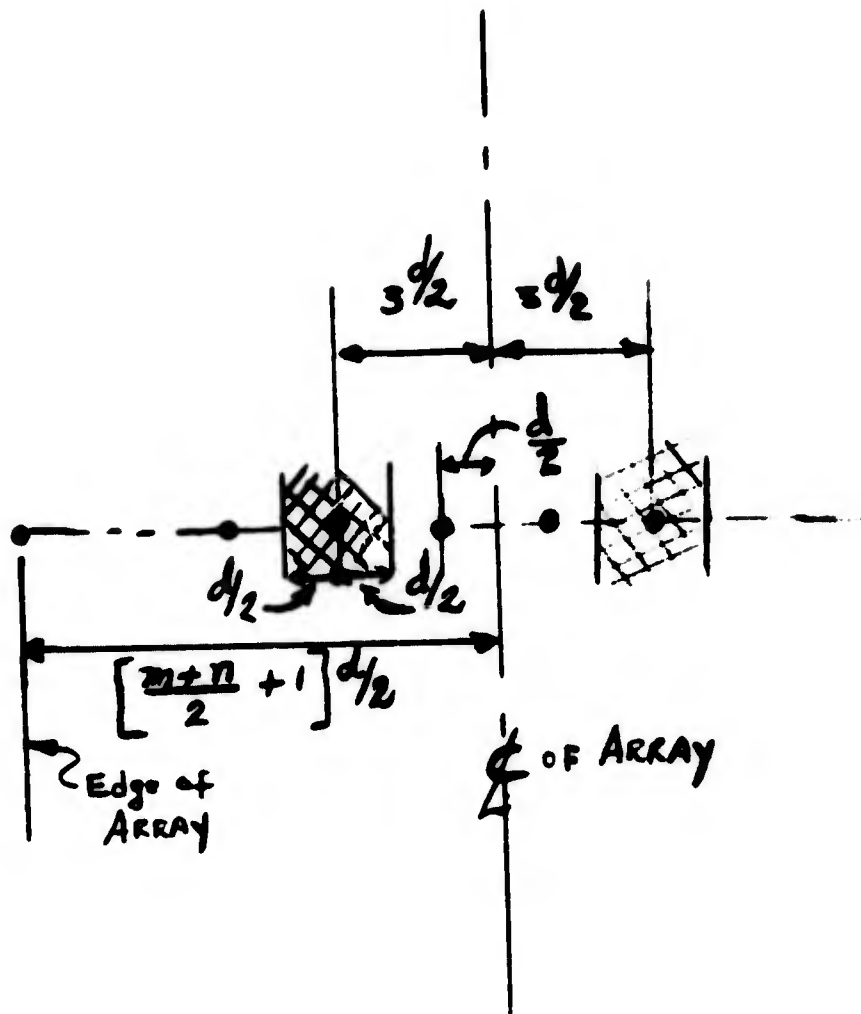


FIG. 1a

GEOMETRY OF IDEALIZED RING RADIATOR
IN PLANE OF ARRAY

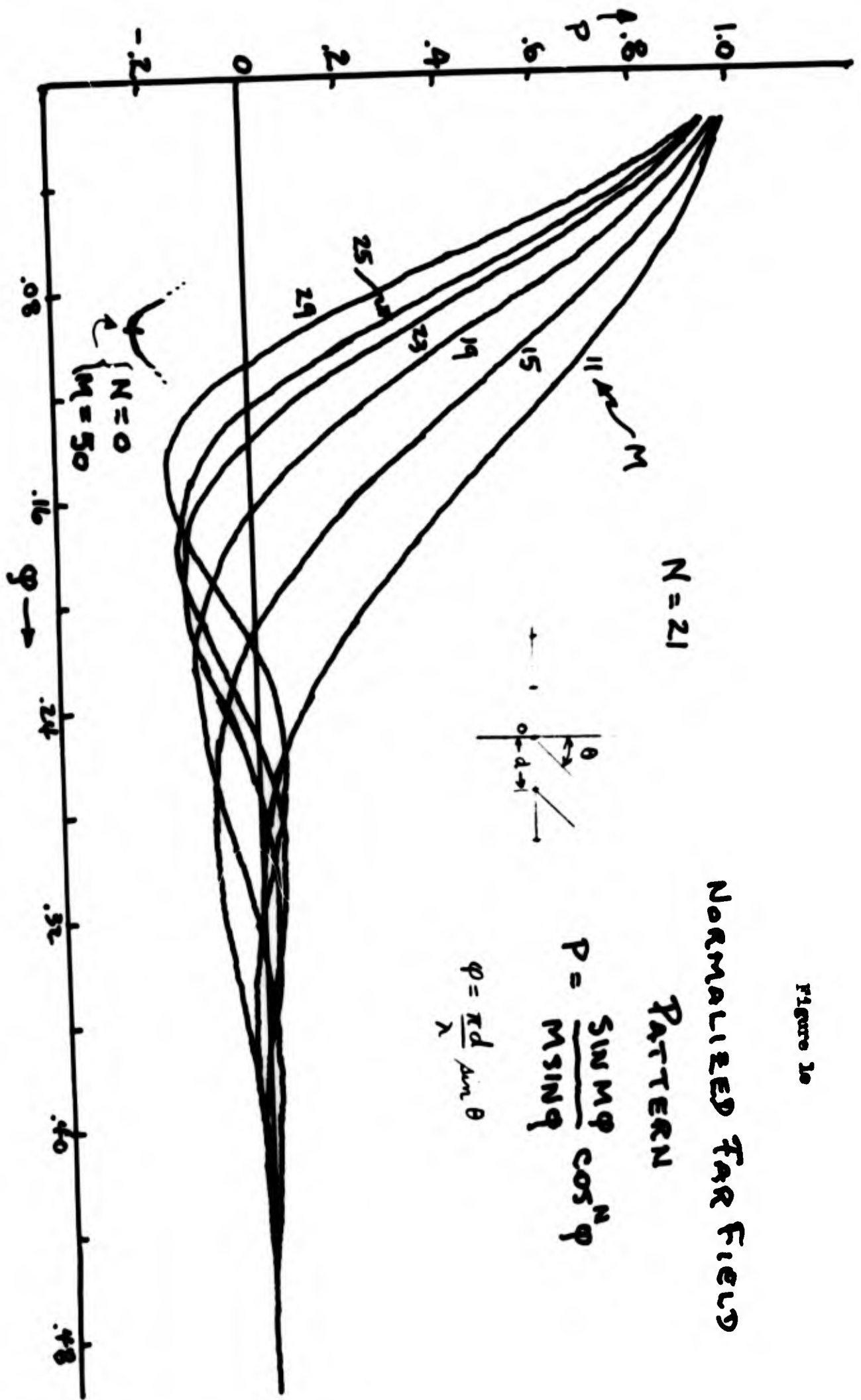
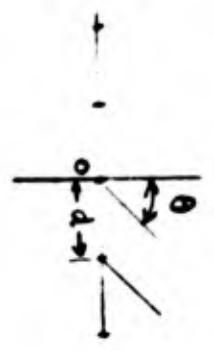
Figure 1a

NORMALIZED FAR FIELD PATTERN

$N = 21$

$$P = \frac{\sum_{m=0}^M \cos^m \varphi}{M \sin \varphi}$$

$$\varphi = \frac{\pi d}{\lambda} \sin \theta$$



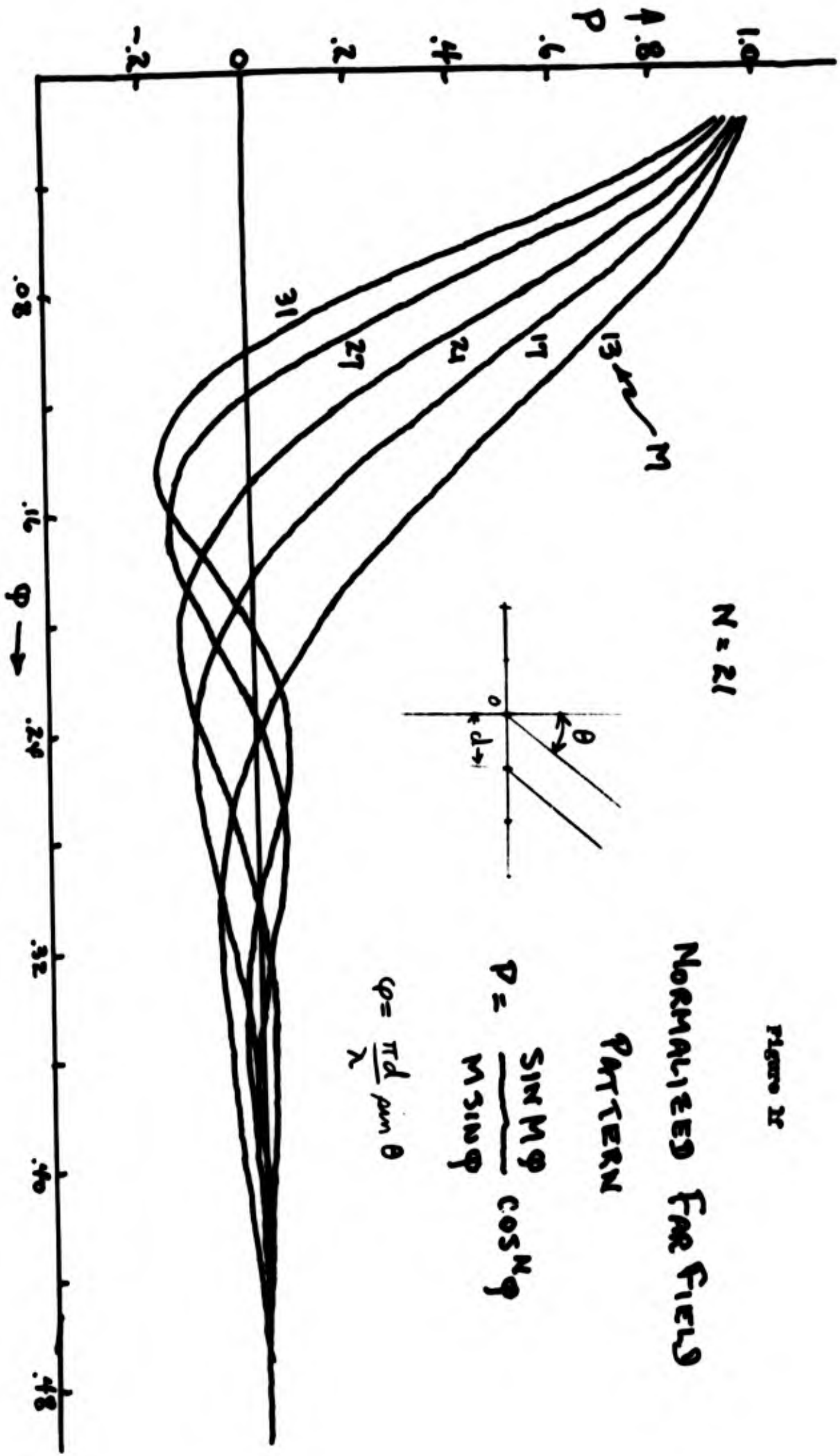
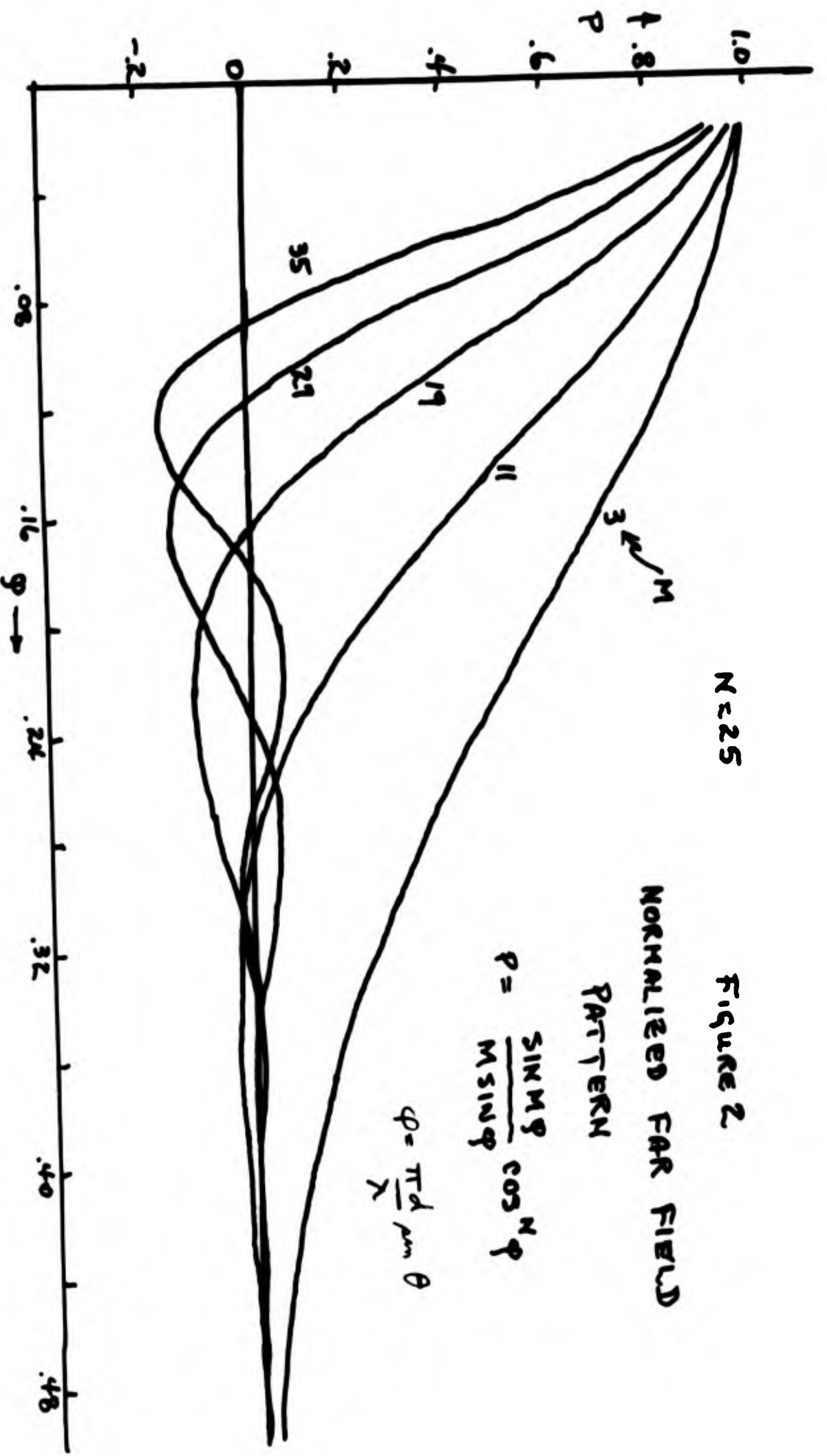


Figure 2x



$N=25$

Figure 2

NORMALIZED FAR FIELD
PATTERN

$$P = \frac{\sin M \phi}{M \sin \phi} \cos^N \phi$$

$$\phi = \frac{\pi d}{\lambda} \sin \theta$$

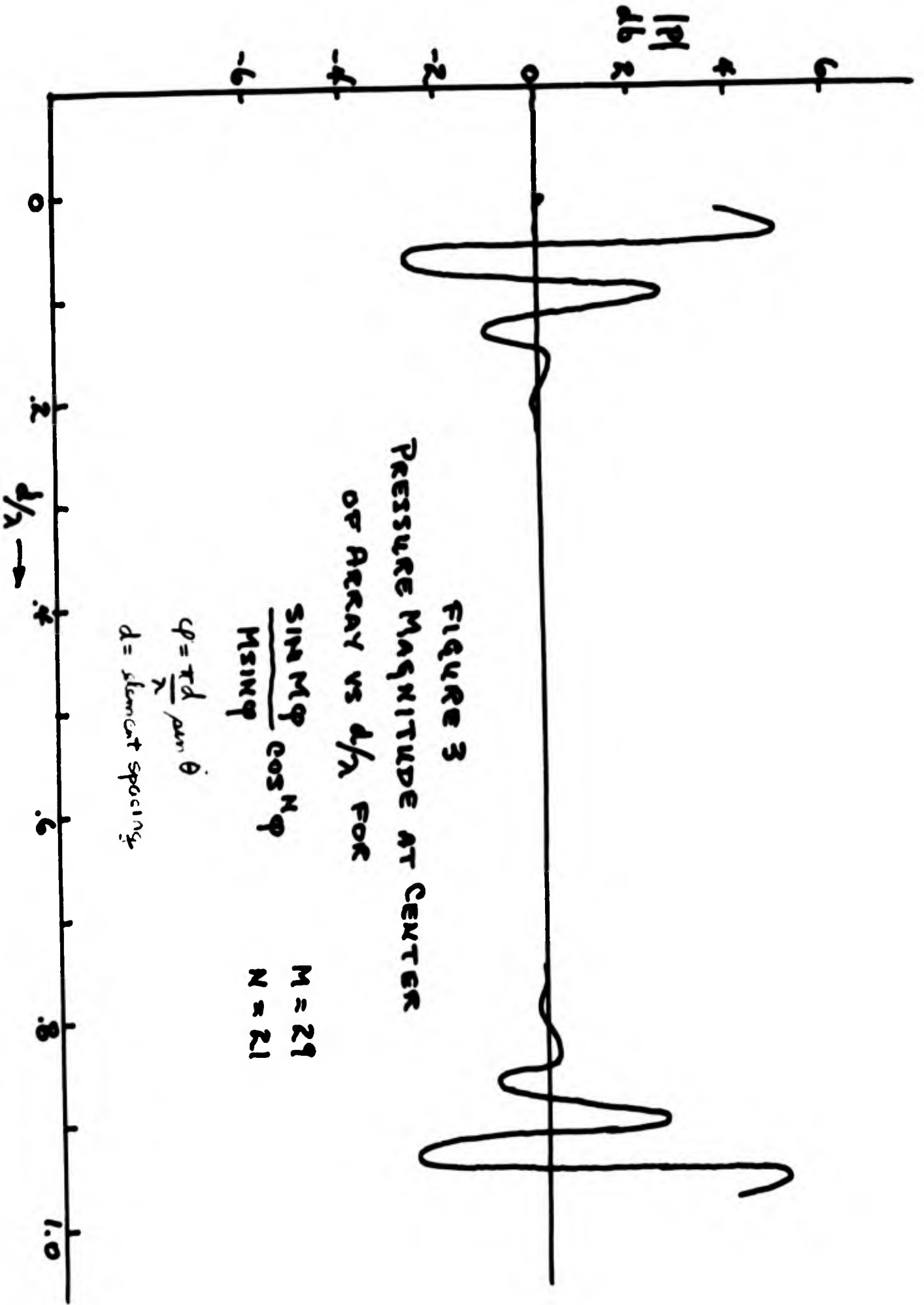


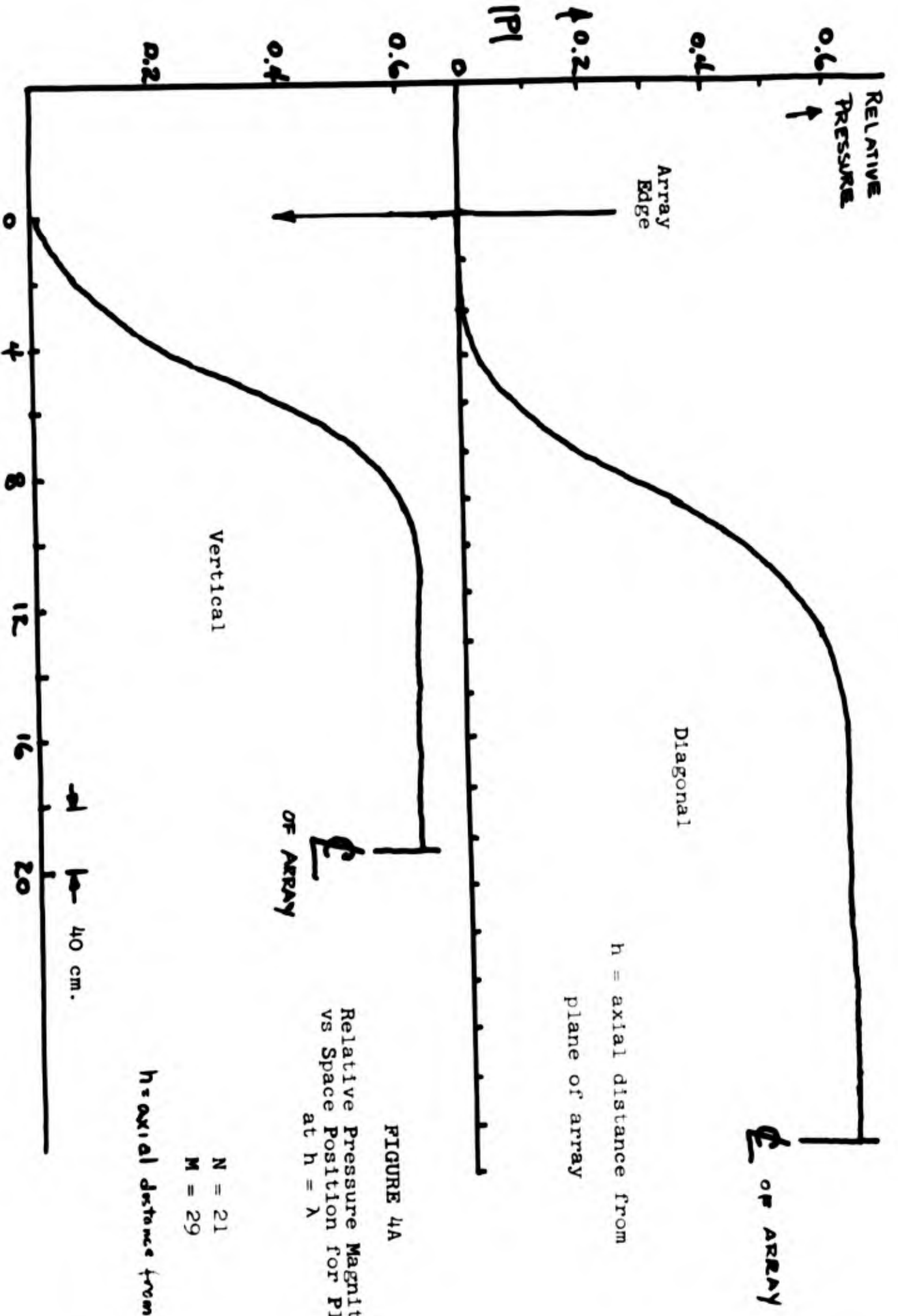
FIGURE 3
 PRESSURE MAGNITUDE AT CENTER
 OF ARRAY VS d/λ FOR

$$\frac{\sin M\phi}{M \sin \phi} \cos N\phi$$

$M = 29$
 $N = 21$

$$\phi = \frac{\pi d}{\lambda} \sin \theta$$

$d = \text{slant cut spacing}$

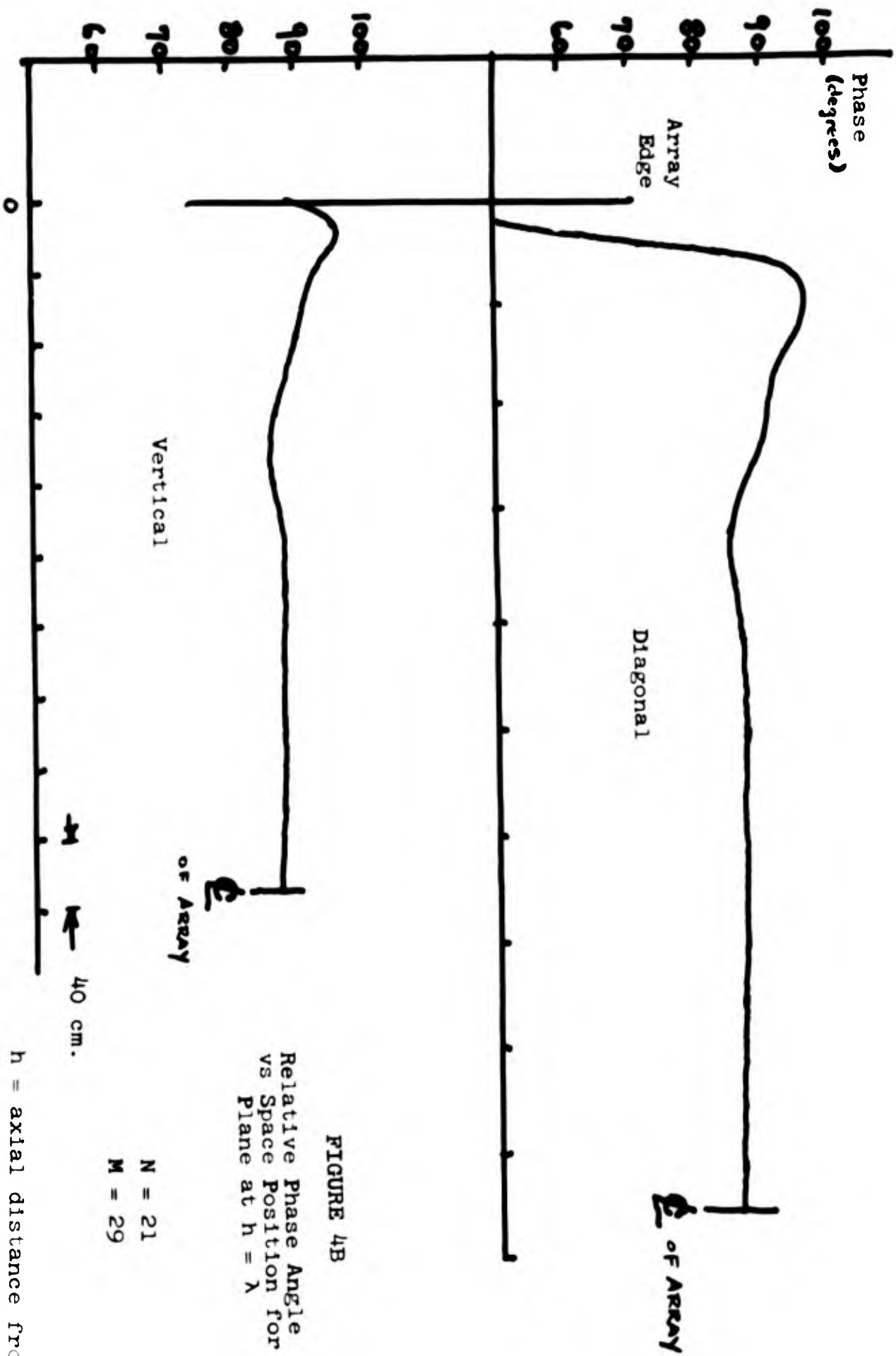


h = axial distance from plane of array

FIGURE 4A
Relative Pressure Magnitude vs Space Position for Plane at $h = \lambda$

N = 21
M = 29

h = axial distance from array



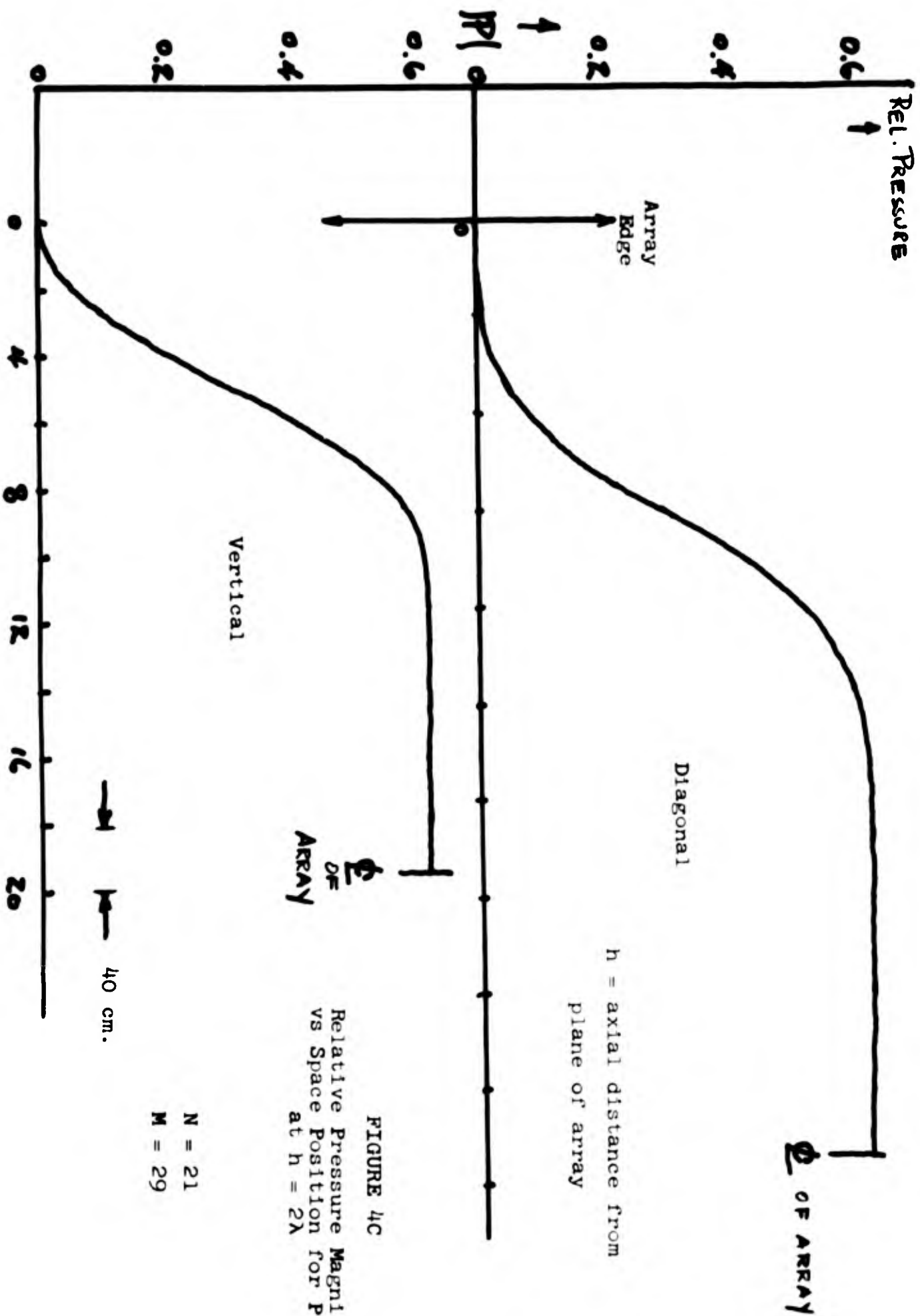


FIGURE 4C
Relative Pressure Magnitude
vs Space Position for Plane
at $h = 2\lambda$

N = 21
M = 29

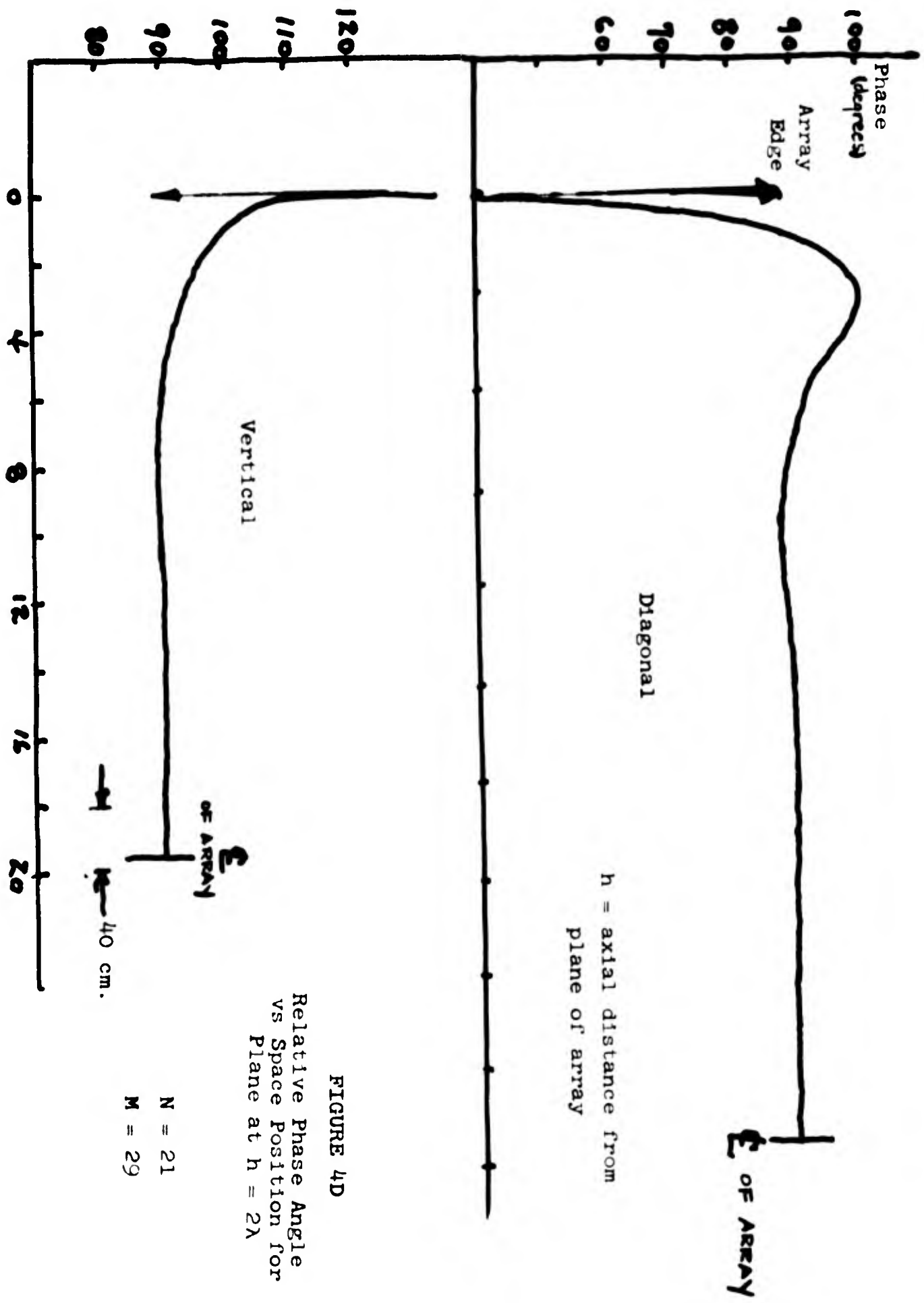
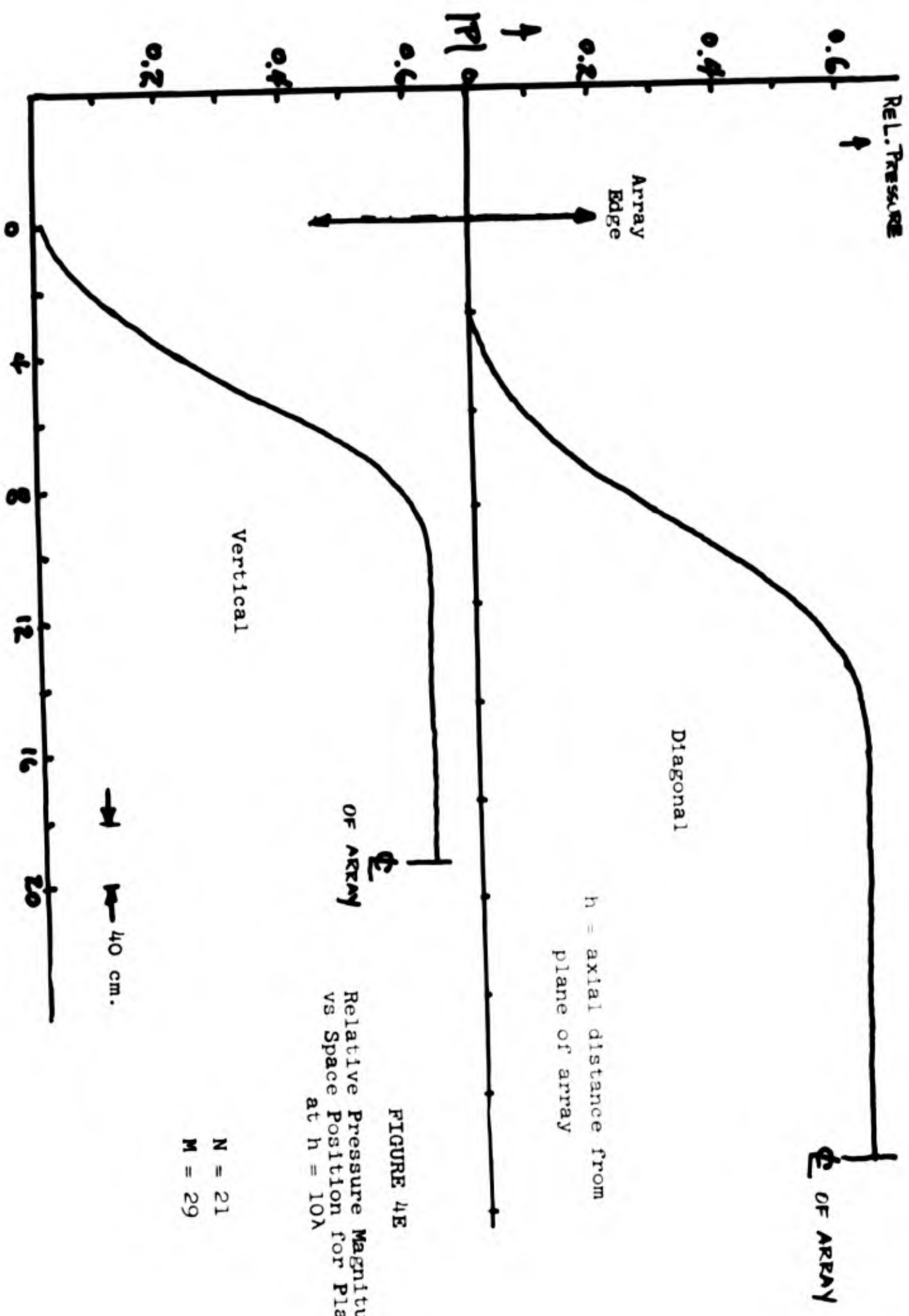
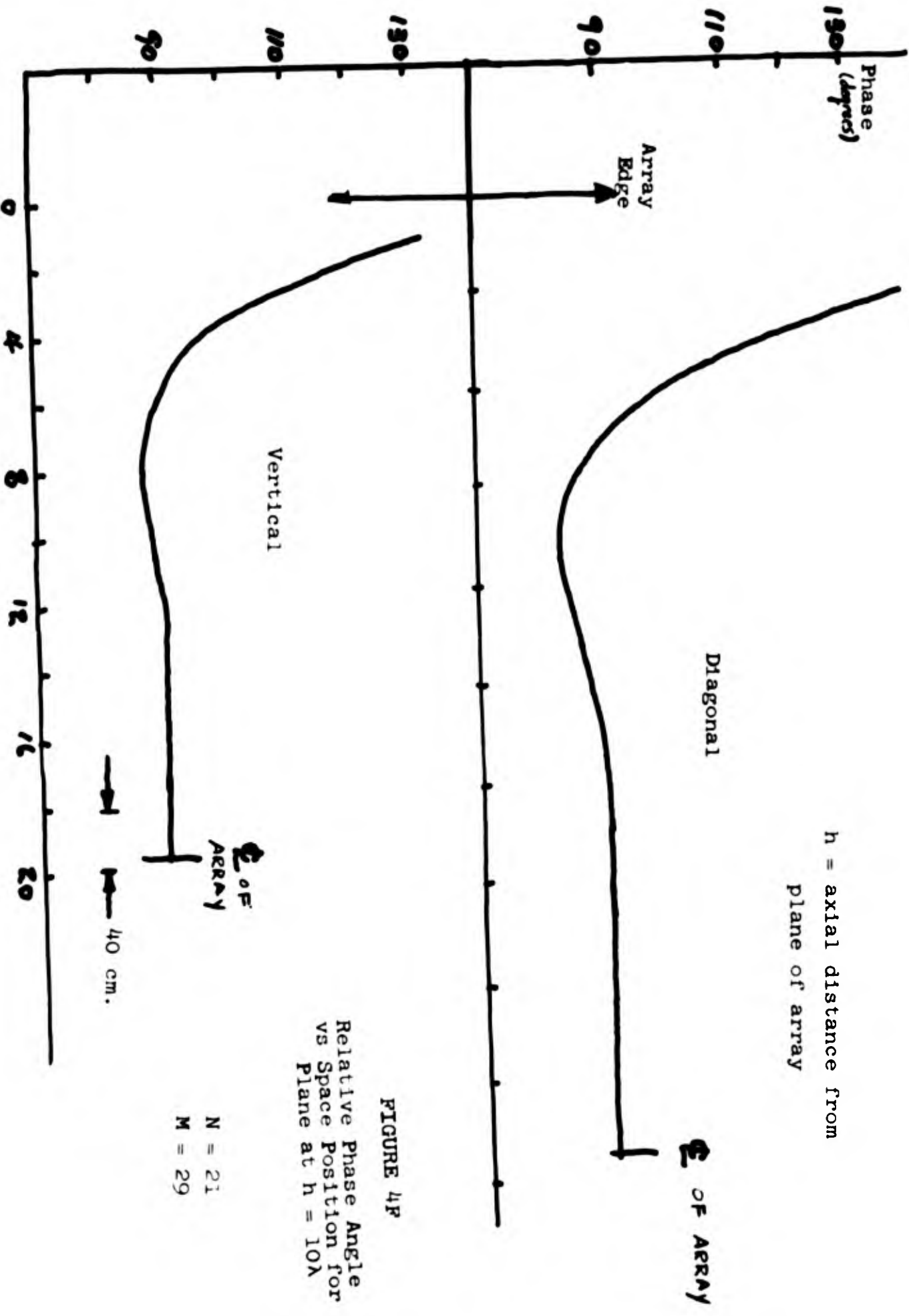


FIGURE 4D
 Relative Phase Angle
 vs Space Position for
 Plane at $h = 2\lambda$

$N = 21$
 $M = 29$





h = axial distance from
plane of array

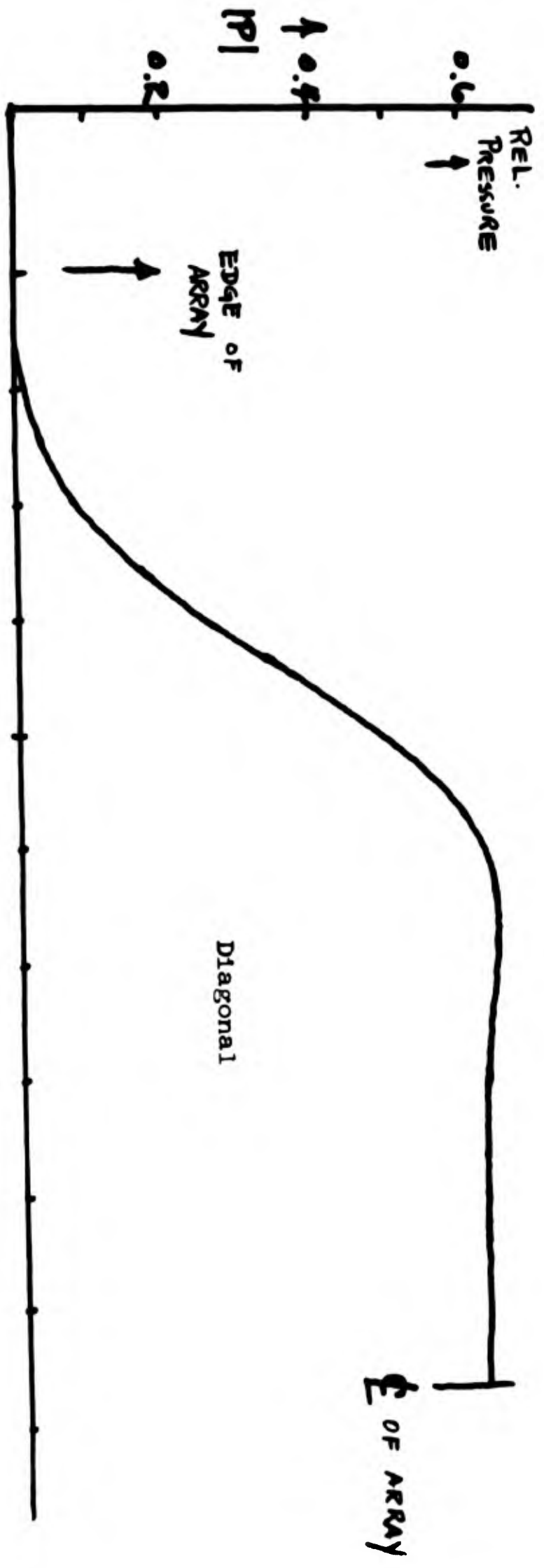


FIGURE 4G
Relative Pressure Magnitude
vs Space Position for Plane
at $h = 20\lambda$

$N = 21$
 $M = 29$

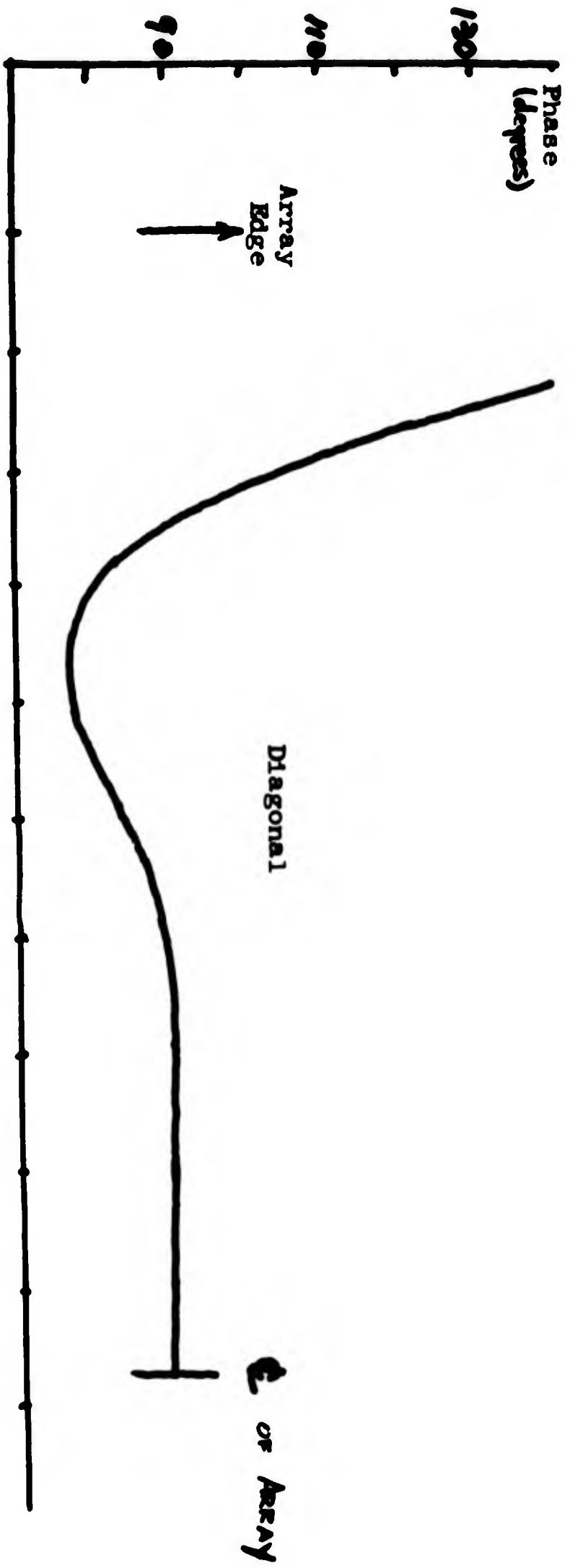


FIGURE 4H.

Relative Phase Angle
vs Space Position for
Plane at $h = 20\lambda$

$N = 21$

$M = 29$

$h =$ axial distance from
plane of array

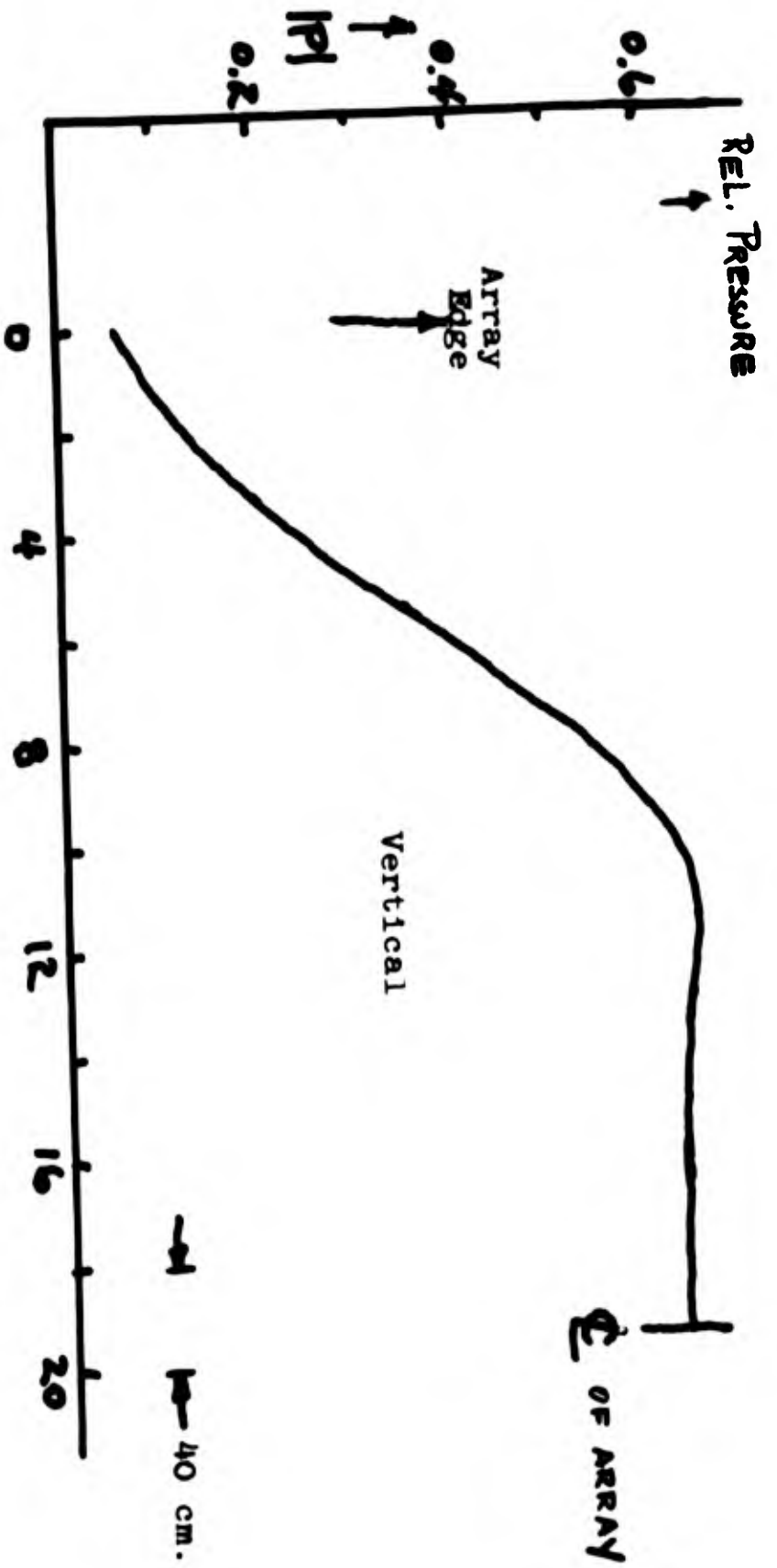


FIGURE 4I

Relative Pressure Magnitude
vs Space Position for Plane
at $h = 30\lambda$

$N = 21$
 $M = 29$

h = axial distance from
plane of array

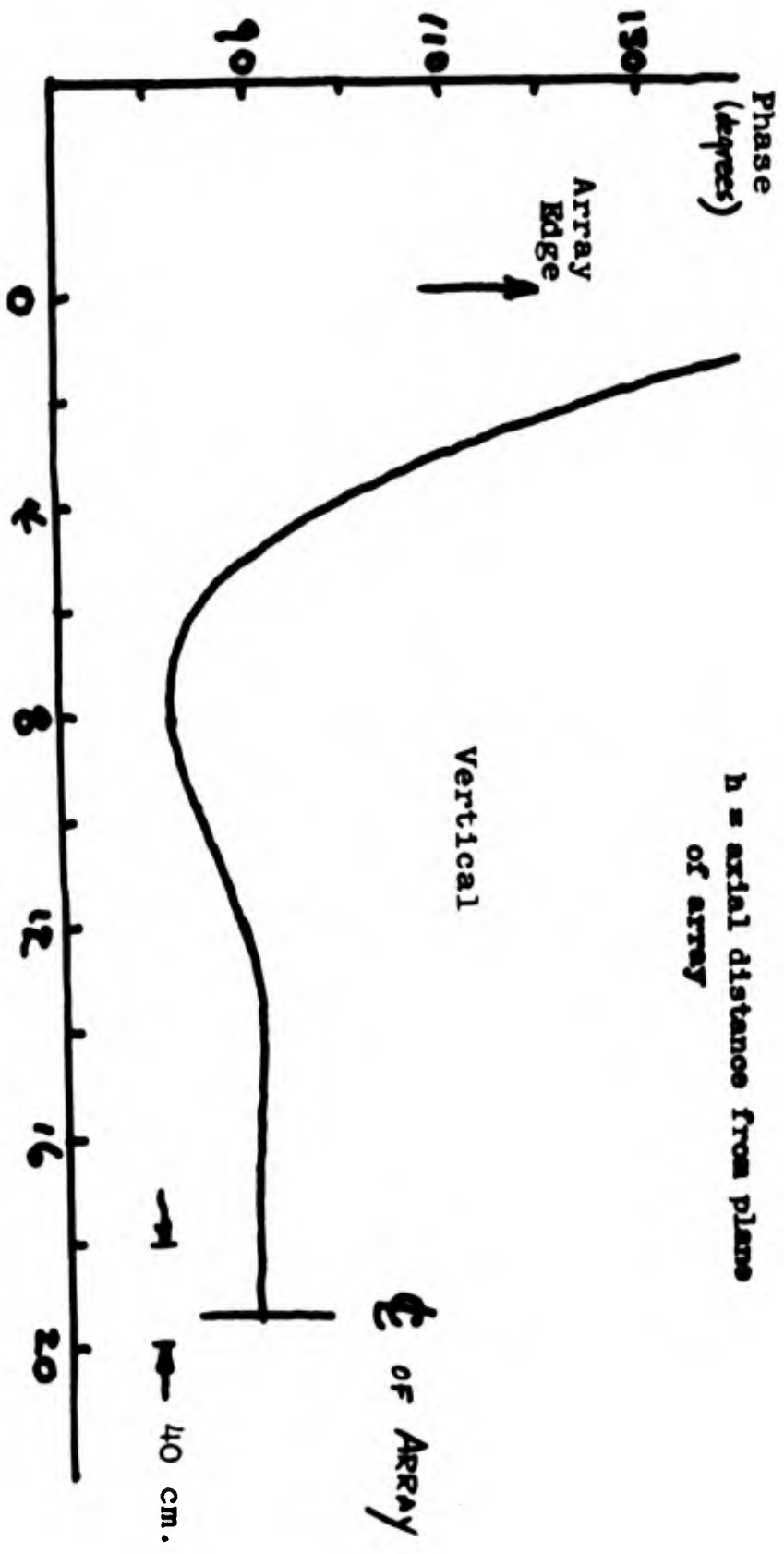


FIGURE 4J

Relative Phase Angle vs Space Position for Plane at $h = 30\lambda$

N = 21
M = 29

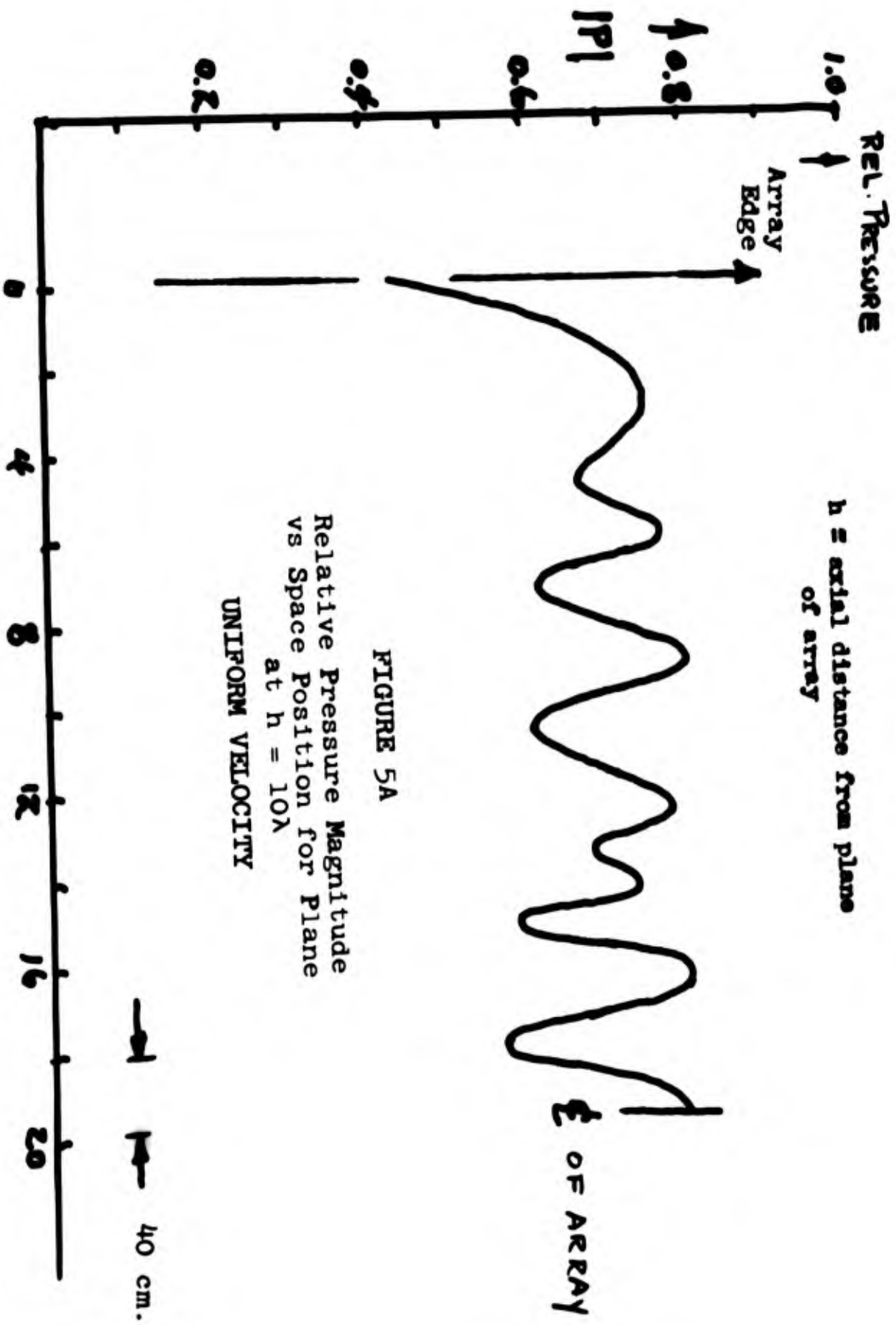


FIGURE 5A
 Relative Pressure Magnitude
 vs Space Position for Plane
 at $h = 10\lambda$
 UNIFORM VELOCITY

$h =$ axial distance from plane of array

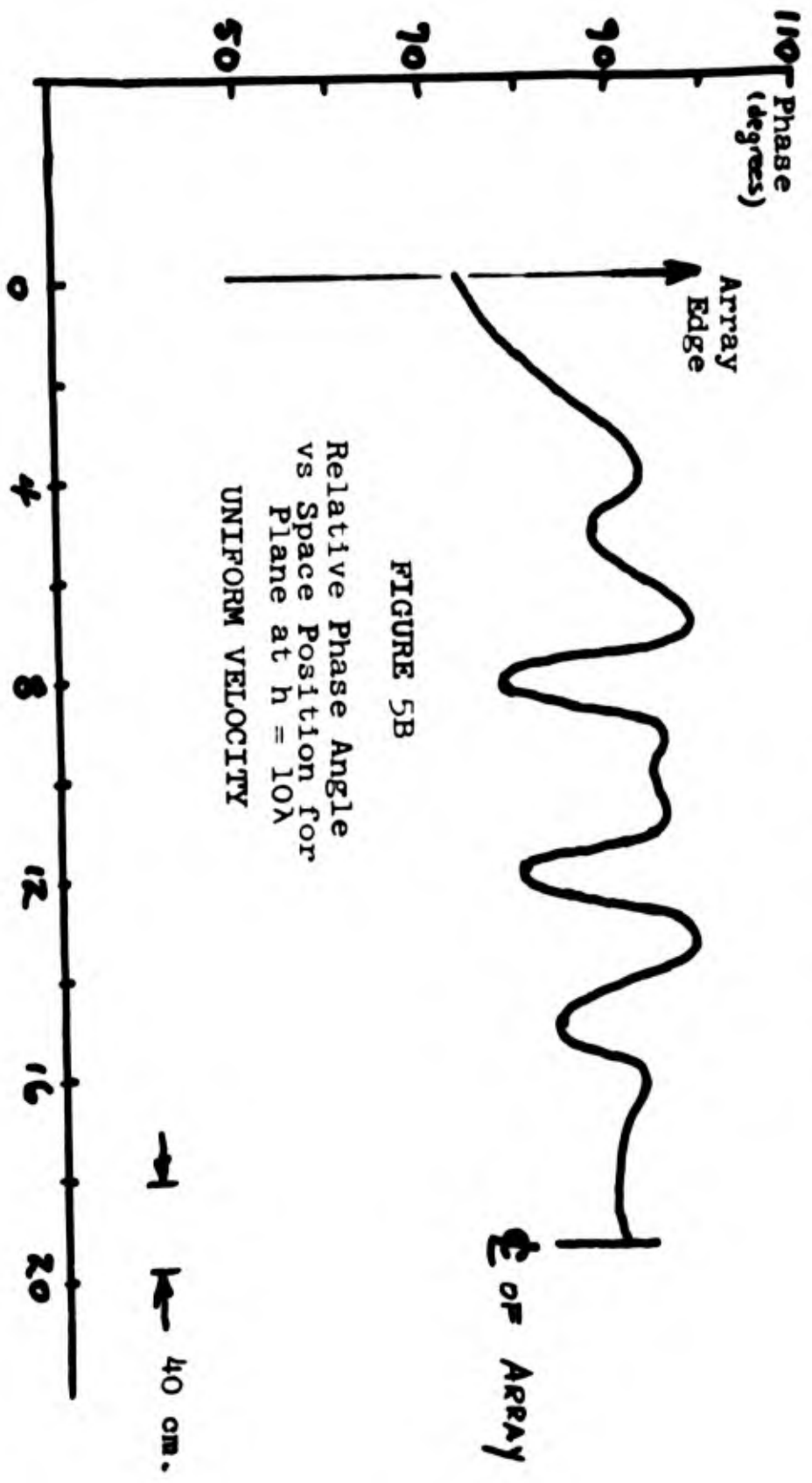
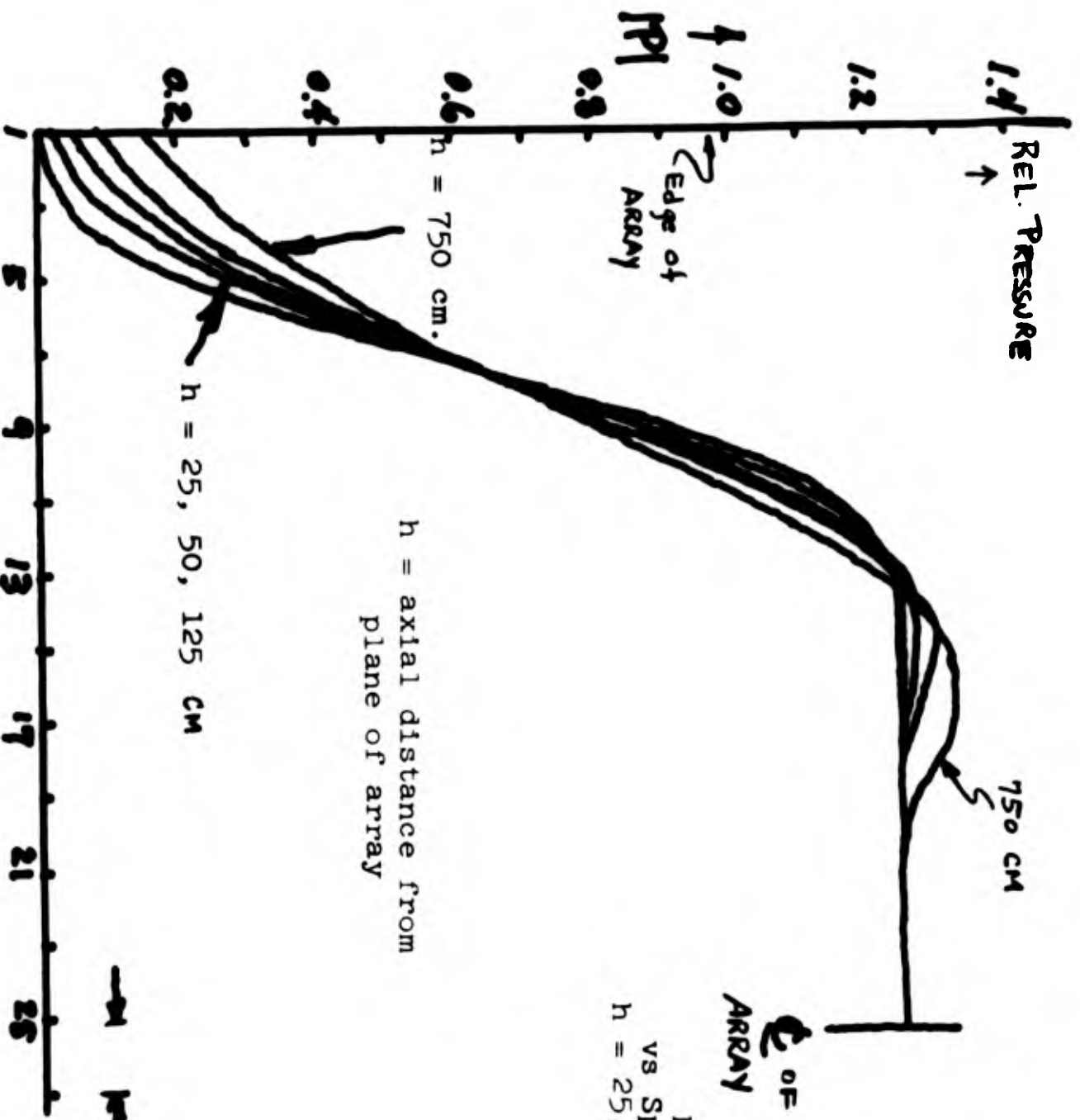


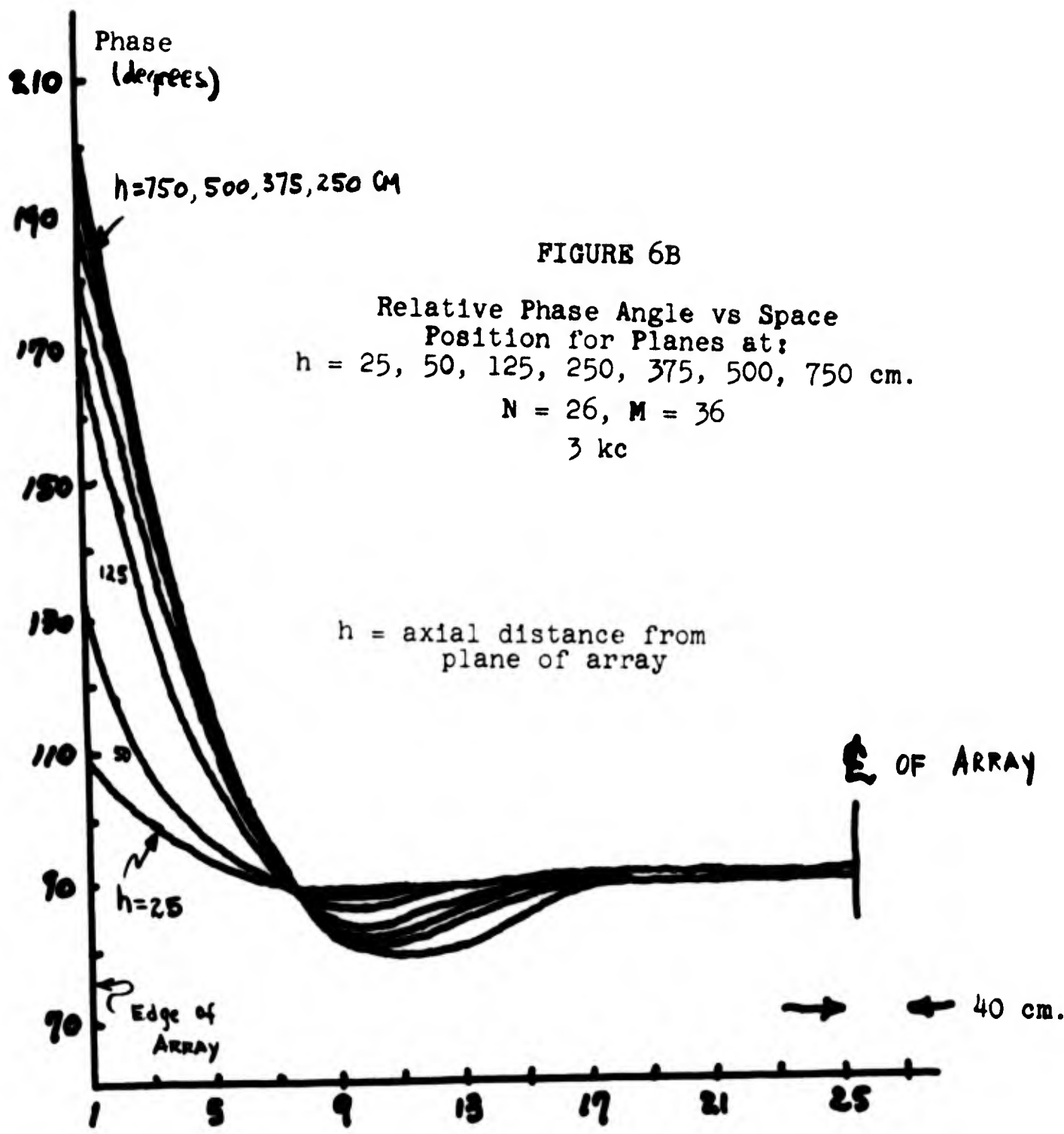
FIGURE 5B

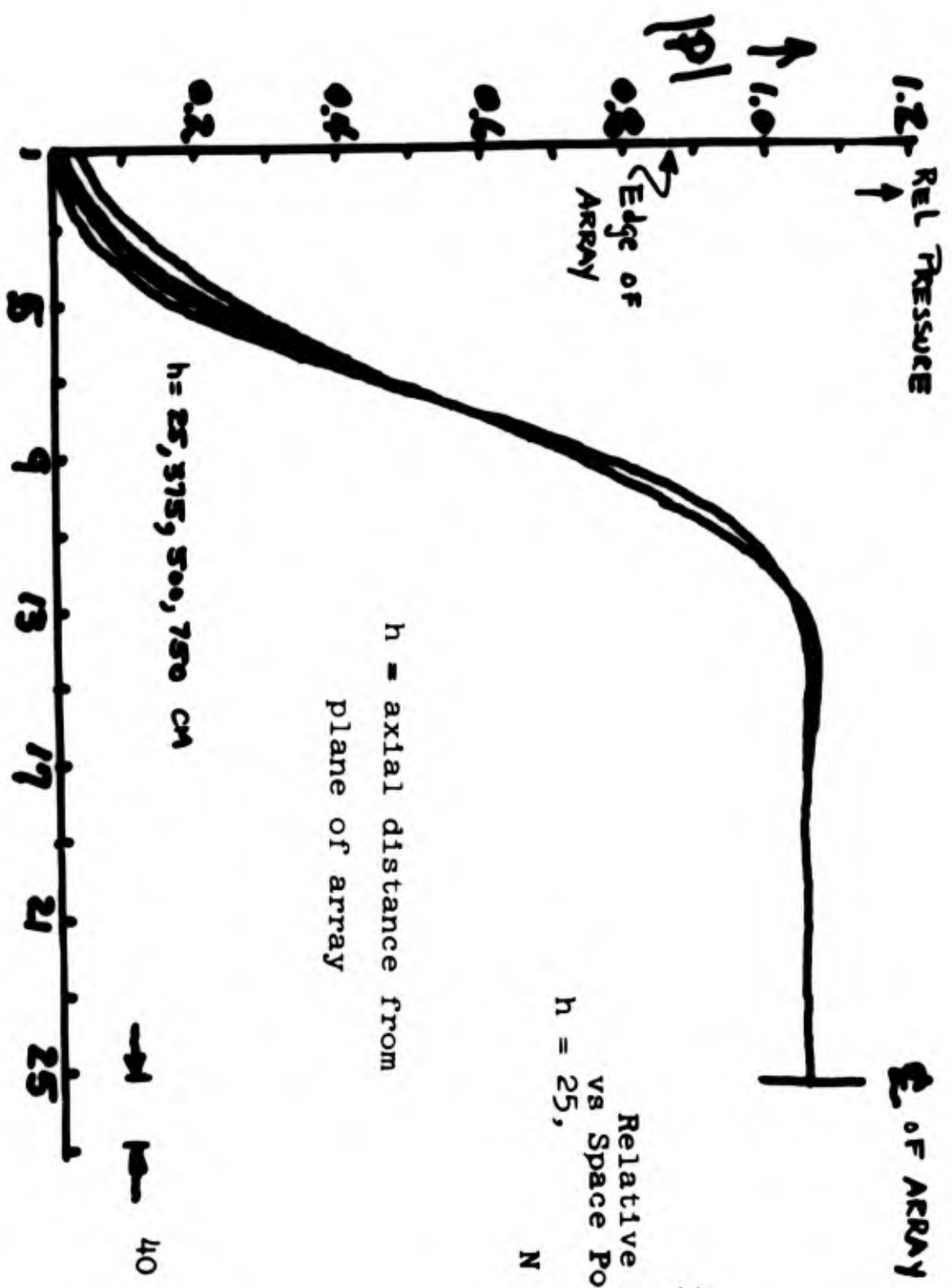
Relative Phase Angle vs Space Position for Plane at $h = 10\lambda$ UNIFORM VELOCITY



Relative Pressure Magnitude
 vs Space Position for Planes at:
 $h = 25, 50, 125, 250, 375, 500, 750 \text{ cm.}$
 $N = 26, M = 36$
 3 kc

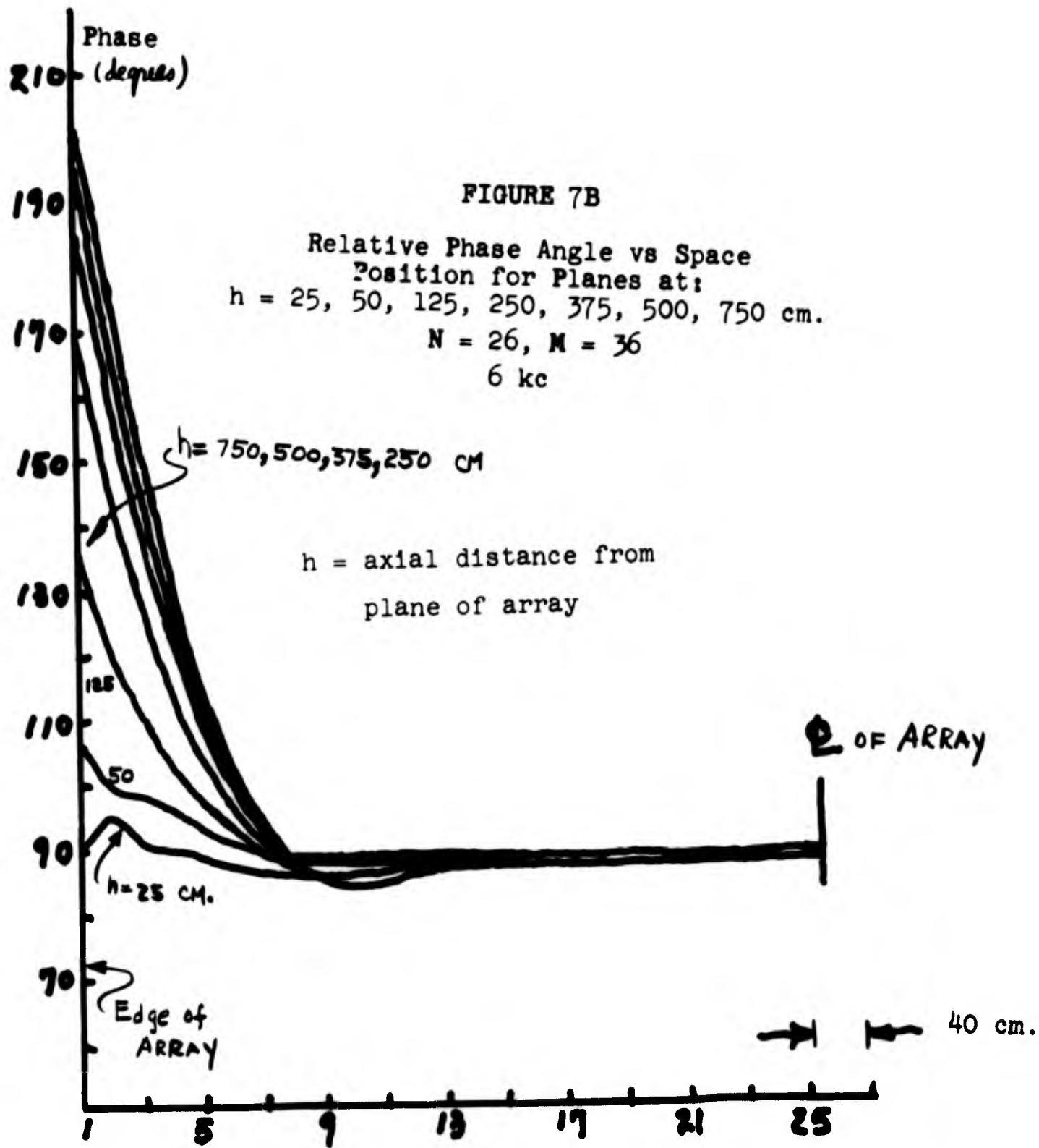
FIGURE 6A





Relative Pressure Magnitude vs Space Position for Planes at: 25, 375, 500, 750 cm. N = 26, M = 36 6 kc

FIGURE 7A



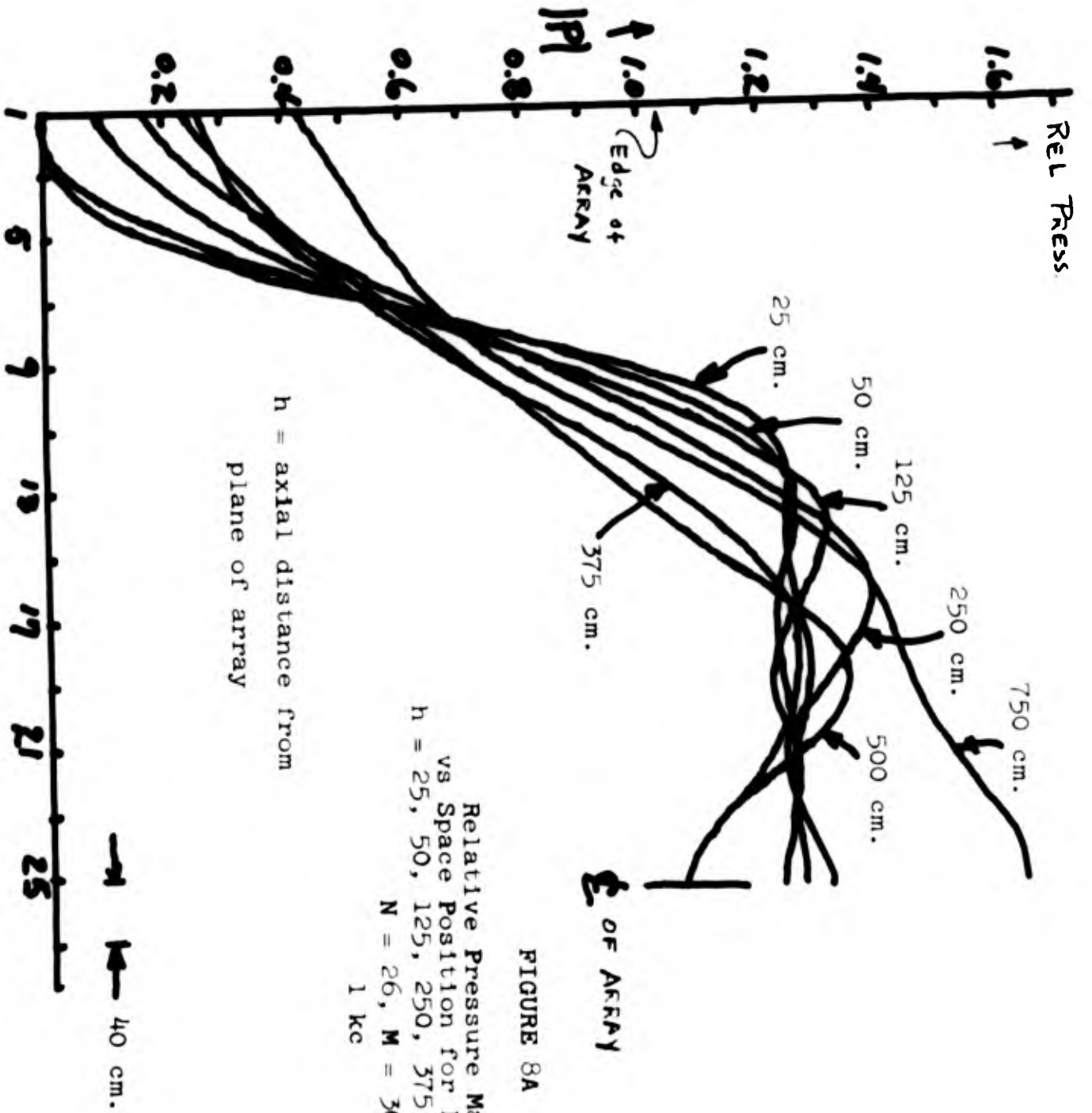
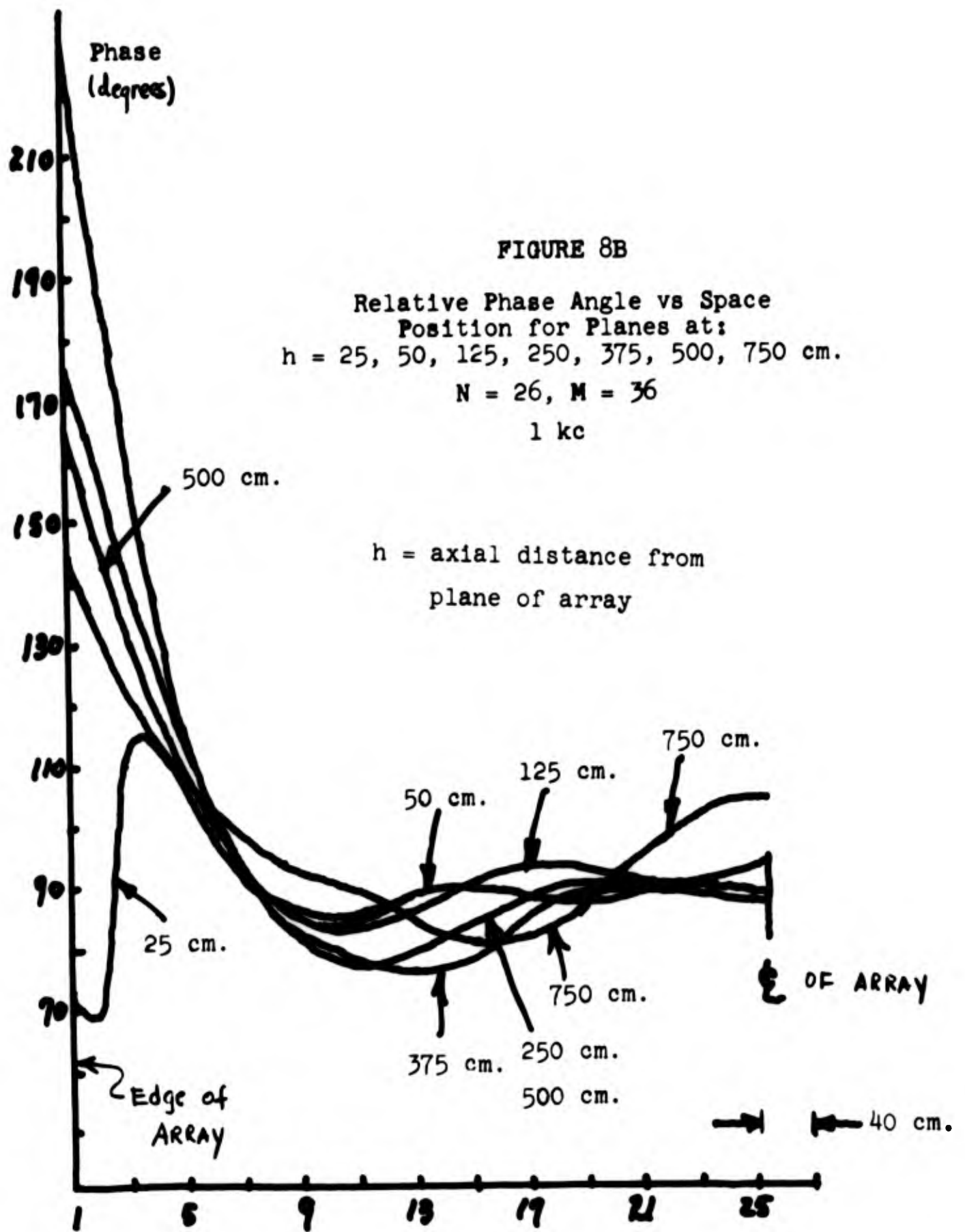
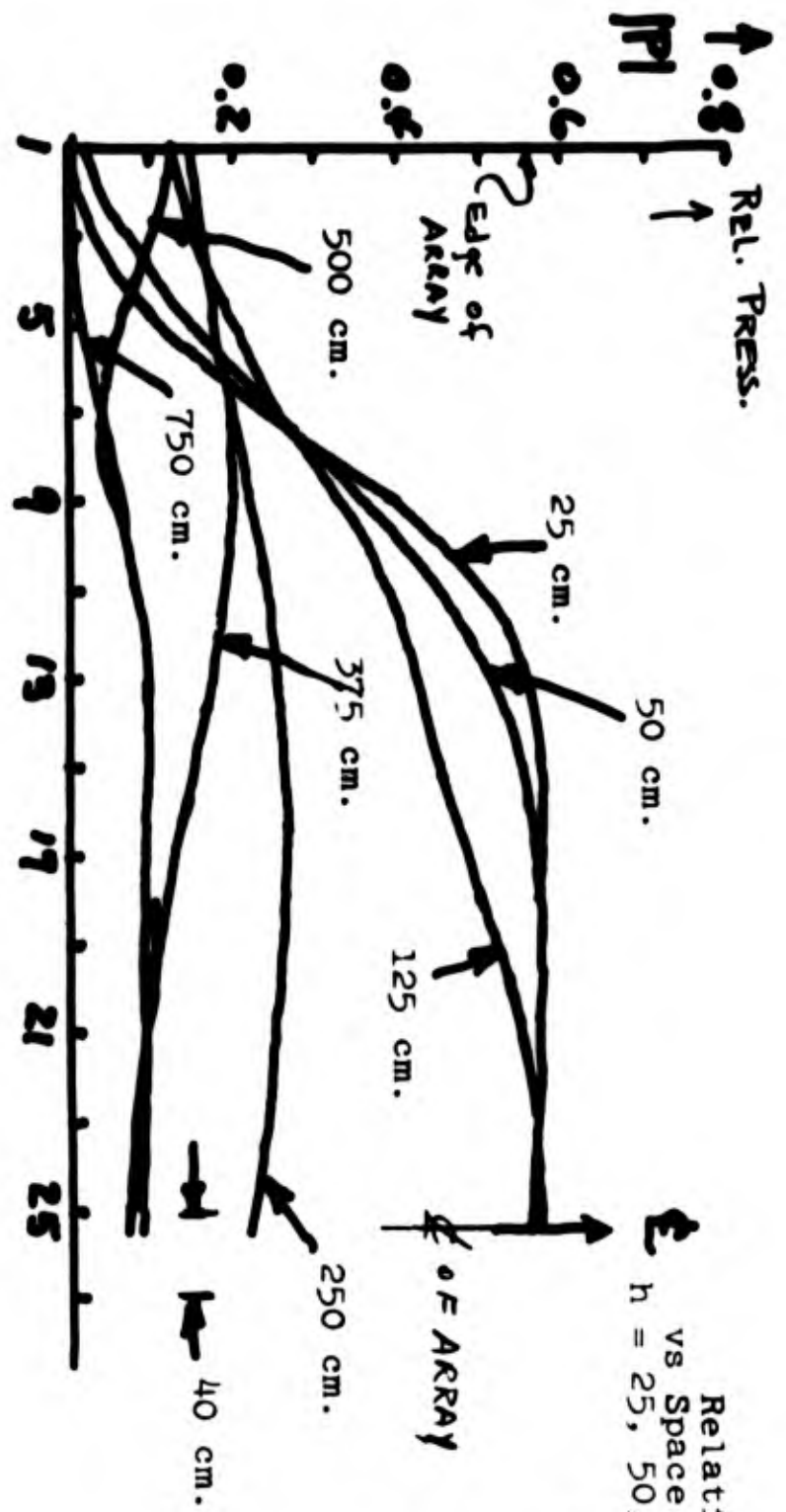


FIGURE 8A

Relative Pressure Magnitude
vs Space Position for Planes at:
h = 25, 50, 125, 250, 375, 500, 750 cm.
N = 26, M = 36
1 kc



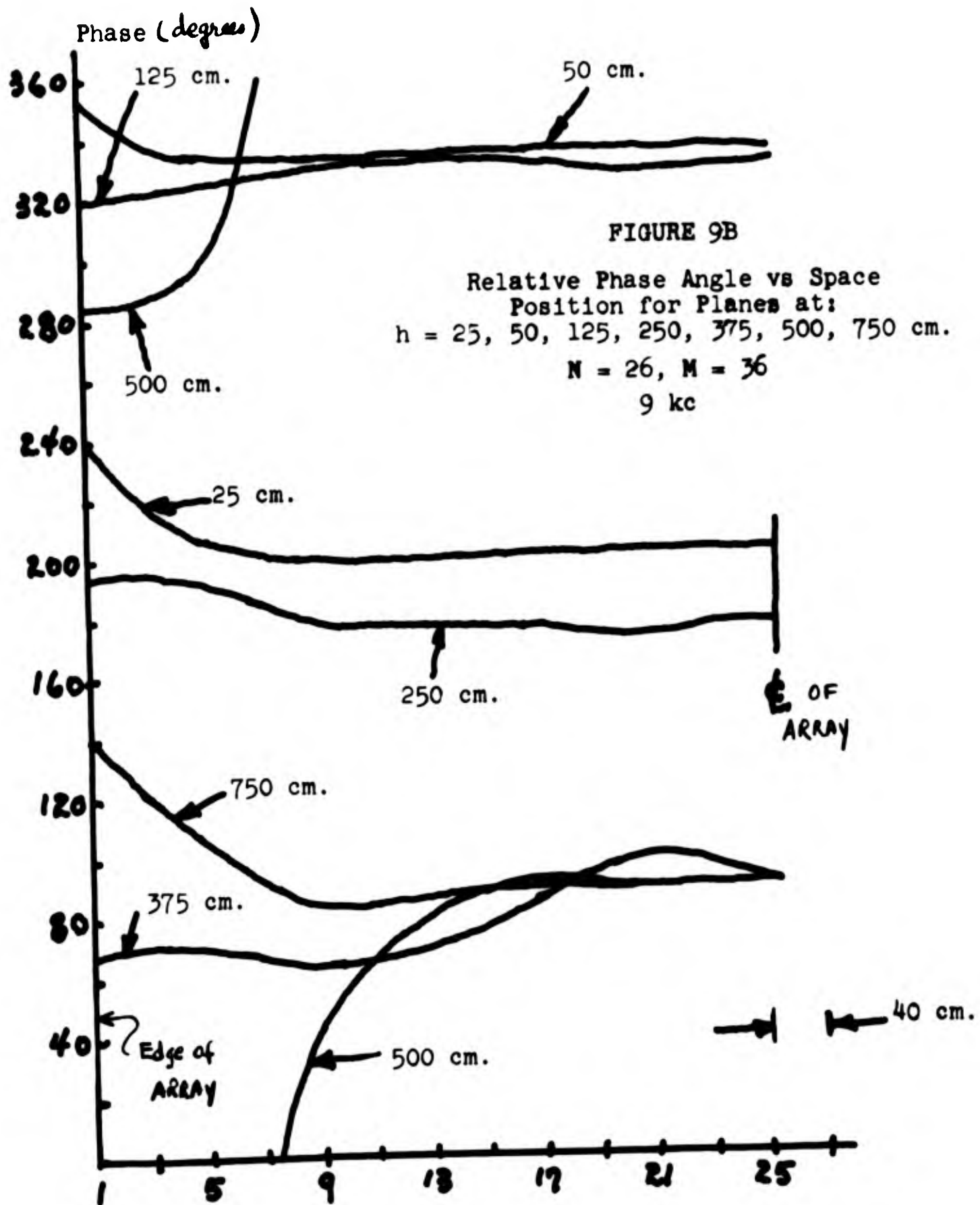
h = axial distance from
plane of array



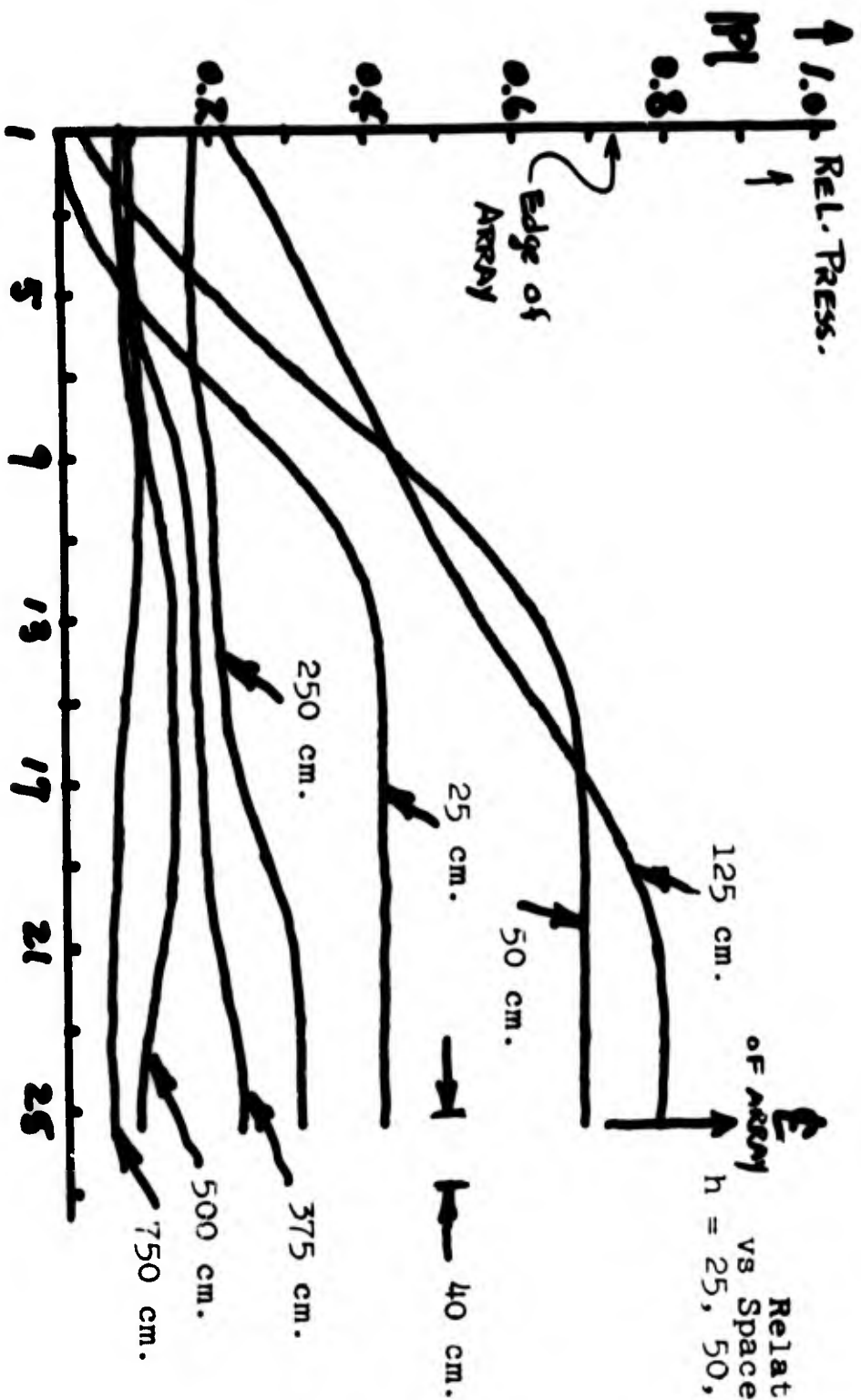
Relative Pressure Magnitude
vs Space Position for Planes at:
h = 25, 50, 125, 250, 375, 500, 750 cm.
N = 26, M = 36
9 kc

FIGURE 9A

h = axial distance from
plane of array



h = axial distance from
plane of array

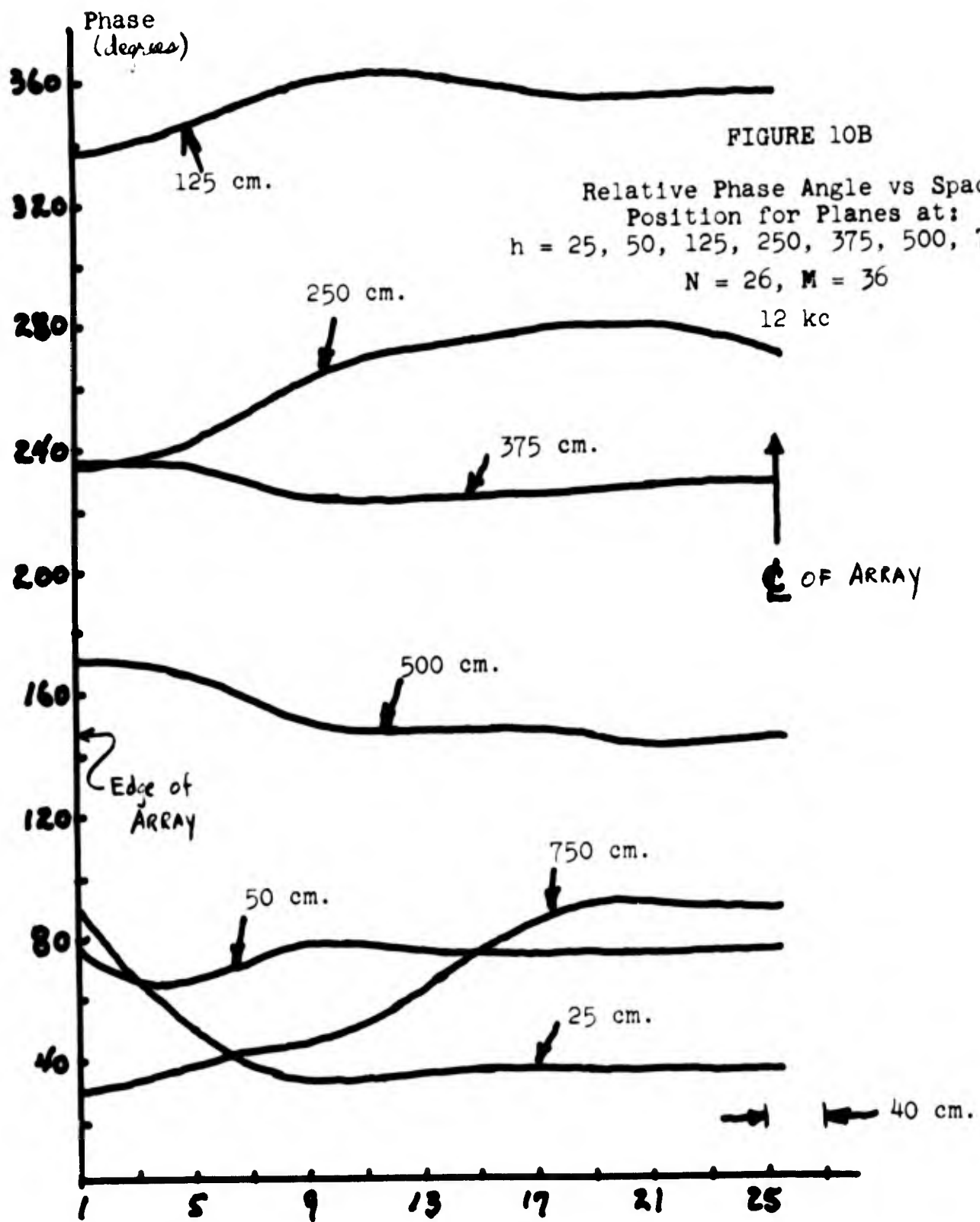


Relative Pressure Magnitude
vs Space Position for Planes at:
 $h = 25, 50, 125, 250, 375, 500, 750$ cm.
 $N = 26, M = 36$
12 kc

FIGURE 10A

NOTE ON TABLES 1A THROUGH 5B

In the following Tables IA through 5B the numbers refer to a matrix of 25 x 25 elements located in the upper left quadrant of the planar arrays of point sources. The tables represent either pressure magnitude or pressure phase. In the magnitude tables the numbers are relative only, the meaning of any entry being established by the value in the corner of the lower right hand side of the table. In the phase tables the numbers are true phase ranging through the positive values 0° to 270° . When a phase is greater than 270° an arbitrary factor of 360° is subtracted from it and the resultant phase appears as a negative number. Thus an entry of -44° means a phase of $316^\circ (= -44^\circ + 360^\circ)$.



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1 Kc. 8" Spacing
 N = 26 M = 50
 50 x 50 Array

TABLE IA

Axial dist. M = 25.0000 CM OR
 PRESSURE TIMES 1000.000
 0.167 WAVELENGTHS
 k = .04

2	3	2	2	1	1	1	2	3	4	5	5	5	5	4	4	3	3	4	4					
3	3	3	2	1	0	0	0	1	2	3	3	3	3	3	2	2	2	1	2	3				
2	3	3	3	2	0	2	4	6	6	4	3	3	3	4	6	6	5	4	4	5	6	7		
2	3	3	2	0	3	8	14	19	22	22	21	20	20	21	22	23	22	21	20	21	22	23		
2	2	2	0	4	11	21	32	41	48	52	52	51	51	52	53	54	53	52	51	50	51	52	53	
1	1	0	3	11	24	40	58	74	87	94	97	96	96	97	99	100	99	98	96	96	96	97	98	
1	0	2	8	21	40	64	91	116	136	148	154	155	155	154	155	157	158	158	154	154	154	155	156	
1	0	4	14	32	58	91	128	162	189	207	216	218	218	218	220	222	221	220	218	217	218	219	220	
1	0	6	19	41	74	116	162	205	240	263	274	278	277	276	277	279	280	281	279	278	277	277	279	280
2	0	6	22	48	87	136	189	240	280	307	321	325	324	323	323	325	327	327	326	325	324	325	326	328
3	1	6	22	52	94	148	207	263	307	337	351	356	354	352	352	354	356	357	356	355	354	355	356	358
4	2	4	22	52	97	154	216	274	321	351	367	371	369	366	366	368	370	371	370	369	368	369	370	372
5	3	3	21	51	97	155	218	278	325	356	371	374	372	370	369	371	374	375	374	372	371	372	373	374
5	3	3	20	51	96	155	218	277	324	354	369	372	370	368	368	371	374	374	373	371	369	370	371	373
5	3	3	20	51	96	154	218	276	323	352	366	370	368	366	368	371	374	374	372	370	368	368	370	371
5	3	4	21	52	97	155	218	277	323	352	366	369	368	368	370	373	376	376	374	371	369	370	372	374
5	3	6	22	53	99	157	220	279	325	354	368	371	371	371	373	377	380	380	377	373	372	373	376	378
5	3	6	23	54	100	158	222	280	327	356	370	374	374	374	376	380	383	382	378	375	374	376	379	382
4	2	6	23	53	99	158	221	281	327	357	371	375	374	374	376	380	382	381	377	374	373	376	380	383
4	2	5	22	52	98	156	220	279	326	356	370	374	373	372	374	377	378	377	374	371	370	373	377	381
3	2	4	21	51	96	154	218	278	325	355	369	372	371	370	371	373	375	374	371	368	367	370	374	377
3	2	4	20	50	96	154	217	277	324	354	368	371	369	368	369	372	374	373	370	367	367	369	372	375
3	1	5	21	51	96	154	218	277	325	355	369	372	370	368	370	373	376	376	373	370	369	370	373	375
4	2	6	22	52	97	155	219	279	326	356	370	373	371	370	372	376	379	380	377	374	372	373	375	377
4	3	7	23	53	98	156	220	280	328	358	372	374	373	371	374	378	383	381	377	374	372	373	375	377

112

1 Kc, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

TABLE IA
 0.333 WAVELENGTHS
 k = .04

axial dist. M= 50.0000 CM OR
 PRESSURE TIMES 1000.000

3	3	3	2	2	1	1	2	3	4	6	6	6	5	5	4	4	4	4	4	3	4			
3	3	3	3	2	2	3	4	5	6	7	8	8	7	5	4	4	5	6	7	6	4	3		
3	3	3	3	3	4	7	9	12	13	15	16	17	17	16	14	13	13	14	15	16	15	13	12	
2	3	3	3	5	9	15	21	26	30	33	34	35	36	35	33	33	33	34	35	35	34	32	31	
2	2	3	5	10	18	28	39	48	56	61	65	67	67	66	65	64	64	65	66	66	65	64	63	
1	2	4	9	18	31	47	63	79	92	101	107	110	111	110	108	108	108	109	110	109	108	107	106	
1	3	7	15	28	47	69	94	117	136	150	158	163	164	163	161	160	160	161	162	163	162	160	159	
1	3	9	21	39	63	94	126	157	182	202	214	220	221	219	217	216	216	217	219	220	220	219	217	216
2	4	12	26	48	79	117	157	195	227	251	266	274	275	273	270	268	268	270	272	274	274	273	271	270
3	5	13	30	56	92	136	182	227	265	293	311	319	321	318	314	312	312	314	317	319	319	318	316	314
4	6	15	33	61	101	150	202	251	293	324	344	353	355	351	347	343	343	346	349	352	352	350	348	346
6	7	16	34	65	107	158	214	266	311	344	365	375	376	372	367	364	364	366	370	373	373	370	367	365
6	8	17	35	67	110	163	220	274	319	353	375	385	387	382	377	373	373	377	381	383	383	380	376	374
6	8	17	36	67	111	164	221	275	321	355	376	387	388	384	378	375	375	379	383	386	385	382	378	375
6	7	16	35	66	110	163	219	273	318	351	372	382	384	380	375	372	373	376	380	383	382	379	375	372
5	5	14	33	65	108	161	217	270	314	347	367	377	378	375	370	368	369	372	376	378	378	375	371	368
5	4	13	33	64	108	160	216	268	312	343	364	373	375	372	368	365	366	369	373	375	375	372	369	367
4	4	13	33	64	108	160	216	268	312	343	364	373	375	373	369	366	366	369	372	374	374	372	370	368
4	5	14	33	65	108	161	217	270	314	346	366	377	379	376	372	369	369	371	374	376	376	375	372	371
4	6	15	34	66	109	162	219	272	317	349	370	381	383	380	376	373	372	374	376	378	378	377	375	374
5	7	16	35	66	110	163	220	274	319	352	373	383	386	383	378	375	374	376	378	380	380	379	377	376
4	7	16	35	66	109	163	220	274	319	352	373	383	385	382	378	375	374	376	378	380	380	379	377	375
4	6	15	34	65	108	162	219	273	318	350	370	380	382	379	375	372	372	375	377	379	379	377	374	373
3	4	13	32	64	107	160	217	271	316	348	367	376	378	375	371	369	370	372	375	377	377	374	372	370
4	3	12	31	63	106	159	216	270	314	346	365	374	375	372	368	367	368	371	374	376	375	373	370	368

TABLE IA

1 Ke, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

axial dist. = 125.0000 CM CR 0.033 WAVELENGTHS
 PRESSURE TIMES 1000.000 K = .04

4	4	5	6	7	8	10	13	16	19	23	25	26	27	27	27	27	27	26	25	24	24	24	24	25	26	27
4	5	6	8	9	11	14	18	23	27	32	35	37	37	37	37	36	35	35	34	34	35	35	35	36	36	36
5	6	8	10	13	17	21	26	32	39	45	49	52	53	52	51	50	49	49	49	50	50	50	50	51	51	51
6	8	10	14	18	24	30	38	46	55	63	69	73	74	73	71	70	69	69	70	70	71	71	71	71	71	71
7	9	13	18	25	33	42	52	64	75	86	94	100	101	100	98	95	94	94	96	97	98	98	97	97	97	97
8	11	17	24	33	44	56	70	85	100	114	125	132	134	133	130	127	126	126	127	129	130	130	129	128	128	128
10	14	21	30	42	56	73	91	110	129	147	161	169	173	171	168	164	162	162	164	166	167	167	167	166	165	165
13	18	26	38	52	70	91	114	138	161	183	200	211	215	214	210	206	203	203	204	207	208	207	206	205	205	205
16	23	32	46	64	85	110	138	166	195	220	241	254	260	259	255	250	247	246	247	250	251	250	249	248	248	248
19	27	39	55	75	100	129	161	195	228	258	282	298	305	304	300	294	289	290	292	294	293	293	291	290	290	290
23	32	45	63	86	114	147	183	220	258	292	319	337	345	345	340	334	330	328	329	332	333	332	331	330	330	330
25	35	49	69	94	125	161	200	241	282	319	349	368	378	378	372	366	361	359	360	363	364	364	363	362	362	362
26	37	52	73	100	132	169	211	254	298	337	368	389	399	399	393	385	380	378	380	383	385	385	385	384	383	383
27	37	53	74	101	134	173	215	260	305	345	378	399	408	407	401	393	387	385	387	391	393	394	394	393	392	392
27	37	52	73	100	133	171	214	259	304	345	378	399	407	406	399	391	385	383	385	389	391	392	391	392	391	390
27	37	51	71	98	130	168	210	255	300	340	372	393	401	399	392	383	377	376	378	382	384	385	384	385	384	383
27	36	50	70	95	127	164	206	250	294	334	366	385	393	391	383	375	370	369	371	375	377	377	377	375	374	374
26	35	49	69	94	126	162	203	247	290	330	361	380	387	385	377	370	365	365	368	371	373	372	372	369	367	367
25	35	49	69	94	126	162	203	246	289	328	359	378	385	383	376	369	365	365	369	372	373	373	371	368	366	366
24	34	49	70	96	127	164	204	247	290	329	360	380	387	385	378	371	368	369	372	376	377	377	374	371	368	368
24	34	50	70	97	129	166	207	250	292	332	363	383	391	389	382	375	371	372	376	380	381	378	378	375	372	372
24	35	50	71	98	130	167	208	251	294	333	364	385	393	391	384	377	373	373	377	381	382	380	377	374	374	374
25	35	50	71	98	130	167	207	250	293	332	364	385	394	392	385	377	372	371	374	378	380	379	377	375	375	375
26	36	51	71	97	129	166	206	249	291	331	363	384	393	391	384	375	369	368	371	375	377	377	375	373	373	373
27	36	51	71	97	129	165	205	248	290	330	362	383	392	390	383	374	367	366	369	372	374	373	372	370	372	372

TABLE IA

1 Kc, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

axial dist. = 250.000 CM OR
 PRESSURE TIMES 1000.000
 1.667 WAVELENGTHS
 k = .04

7	8	11	14	17	20	24	28	31	35	39	43	48	52	55	56	55	53	51	49	48	48	49	50	50	
8	10	13	17	20	25	30	34	39	43	48	53	59	64	68	69	68	66	63	61	59	59	60	61	62	
11	13	16	20	25	31	37	42	48	54	60	67	74	80	84	86	85	82	79	76	74	74	75	76	78	
14	17	20	25	31	38	45	53	60	68	75	84	92	99	104	107	106	103	99	95	93	92	94	96	97	
17	20	25	31	39	47	56	65	75	84	94	104	114	122	129	132	131	127	122	118	115	117	119	121		
20	25	31	38	47	57	68	80	92	103	115	127	139	149	156	160	159	155	149	144	141	143	146	149		
24	30	37	45	56	68	82	96	110	124	139	153	166	178	187	191	190	185	179	173	170	173	177	179		
28	34	42	53	65	80	96	113	130	147	163	180	195	209	219	223	222	217	210	203	200	200	204	208	211	
31	39	48	60	75	92	110	130	150	169	188	207	225	240	251	256	255	249	241	234	230	230	234	239	243	
35	43	54	68	84	103	124	147	169	192	213	234	254	271	283	289	288	281	272	264	260	260	264	270	274	
39	48	60	75	94	115	139	163	188	213	237	261	287	311	333	348	355	354	346	335	325	319	318	323	329	333
43	53	67	84	104	127	153	180	207	234	261	287	311	333	348	355	354	346	335	325	319	318	323	329	333	
48	59	74	92	114	139	166	195	225	254	283	311	338	362	378	386	385	377	365	354	347	346	350	356	361	
52	64	80	99	122	149	178	209	240	271	302	333	362	387	405	414	413	404	391	379	372	371	375	381	386	
55	68	84	104	129	156	187	219	251	283	316	348	378	405	424	433	432	423	409	397	389	389	393	400	404	
56	69	86	107	132	160	191	223	256	289	322	355	386	414	433	443	441	431	417	404	397	397	402	409	414	
55	68	85	106	131	159	190	222	255	288	321	354	385	413	432	441	439	428	414	401	394	394	400	408	414	
53	66	82	103	127	155	185	217	249	281	313	346	377	404	423	431	428	417	402	390	383	384	390	399	405	
51	63	79	99	122	149	179	210	241	272	303	335	365	391	409	417	414	402	387	375	368	369	376	385	392	
49	61	76	95	118	144	173	203	234	264	294	325	354	379	397	404	401	390	375	362	356	357	364	373	379	
48	59	74	93	115	141	170	200	230	260	289	319	347	372	389	397	394	383	368	356	349	350	357	366	372	
48	59	74	92	115	141	170	200	230	260	289	318	346	371	389	397	394	384	369	357	350	351	357	366	372	
49	60	75	94	117	143	173	204	234	264	294	323	350	375	393	402	400	390	376	364	357	357	363	371	377	
50	61	76	96	119	146	177	208	239	270	300	329	356	381	400	409	408	399	385	373	366	366	371	379	384	
50	62	78	97	121	149	179	211	243	274	304	333	361	386	404	414	414	405	392	379	372	372	377	384	389	

TABLE IA

1 Kc, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

axial dist. M = 375.000 CM OR		2.500 WAVELENGTHS																							
PRESSURE TIMES 1000.000		K = .04																							
17	19	21	24	26	29	33	39	45	51	57	63	68	72	75	78	80	83	84	84	84	82	79	75	71	69
19	22	25	27	31	35	39	45	52	60	67	74	80	84	88	91	94	96	96	96	96	96	92	87	83	81
21	25	28	32	36	40	46	53	60	69	78	85	92	97	101	105	108	111	112	112	112	110	106	101	97	94
24	27	32	36	41	46	53	60	69	79	89	98	106	112	116	120	123	126	128	128	128	125	121	115	111	108
26	31	36	41	46	53	60	69	79	90	101	111	120	127	132	137	140	144	145	145	142	137	131	125	122	
29	35	40	46	53	60	68	78	90	102	115	126	137	145	151	156	160	163	165	164	161	155	148	142	136	
33	39	46	53	60	68	78	89	102	116	130	144	155	165	172	178	182	186	188	187	183	176	168	161	157	
39	45	53	60	69	78	89	102	116	132	148	164	177	188	197	203	209	213	215	213	208	200	191	183	179	
45	52	60	69	79	90	102	116	132	151	169	187	202	215	225	233	239	244	246	244	238	229	219	210	205	
51	60	69	79	90	102	116	132	151	171	192	212	230	244	256	265	272	277	279	277	271	261	249	239	234	
57	67	78	89	101	115	130	148	169	192	216	238	258	274	287	297	305	310	313	311	304	293	281	270	264	
63	74	85	98	111	126	144	164	187	212	238	263	285	303	316	327	336	342	345	343	336	324	311	300	293	
68	80	92	106	120	137	155	177	202	230	258	285	308	327	342	353	362	369	372	370	363	351	337	325	318	
72	84	97	112	127	145	165	188	215	244	274	303	327	347	362	374	384	391	395	393	385	372	357	344	337	
75	88	101	116	132	151	172	197	225	256	287	316	342	362	378	391	401	409	413	411	402	388	372	358	350	
78	91	105	120	137	156	178	203	233	265	297	327	353	374	391	404	416	424	428	426	417	401	384	369	360	
80	94	108	123	140	160	182	209	239	272	305	336	362	384	401	416	428	437	442	439	429	412	393	377	368	
83	96	111	126	144	163	186	213	244	277	310	342	369	391	409	424	437	447	452	449	438	420	401	383	373	
84	98	112	128	145	165	188	215	246	279	313	345	372	395	413	428	442	452	457	454	443	425	404	387	377	
84	98	112	128	145	164	187	213	244	277	311	343	370	393	411	426	439	449	454	451	440	422	402	385	375	
82	96	110	125	142	161	183	208	236	271	304	336	363	385	402	417	429	438	443	440	430	413	394	377	368	
79	92	106	121	137	155	176	200	229	261	293	324	351	372	388	401	412	420	425	422	413	398	380	365	356	
75	87	101	115	131	148	168	191	219	249	281	311	337	357	372	384	393	401	404	402	394	380	364	350	342	
71	83	97	111	125	142	161	183	210	239	270	300	325	344	358	369	377	383	387	385	377	365	350	337	330	
69	81	94	108	122	138	157	179	205	234	264	293	318	337	350	360	368	373	377	375	368	356	342	330	323	

TABLE 1A

1 Kc, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

axial	dist.	Hz	500.0000	CW	OR	3.333	WAVELENGTHS																				
								k = .04																			
								PRESSURE TIMES 1000.000																			
18	20	23	27	31	36	41	46	51	55	59	63	68	73	79	85	91	95	96	95	92	87	82	79	77			
20	22	26	29	34	40	45	51	56	61	66	70	76	82	89	96	102	106	107	106	102	97	91	87	85			
23	26	29	33	38	44	51	57	63	69	74	80	86	93	100	108	115	119	121	119	115	109	103	98	95			
27	29	33	38	44	50	57	65	72	78	85	91	98	106	115	123	131	136	137	135	131	124	117	112	109			
31	34	38	44	50	58	66	74	82	90	98	105	113	122	132	142	150	155	157	155	150	143	136	130	126			
36	40	44	50	58	66	75	85	95	104	113	121	130	140	151	162	172	178	180	178	173	165	157	150	147			
41	45	51	57	66	75	86	97	108	119	129	139	149	160	173	185	195	202	205	203	197	189	180	173	169			
46	51	57	65	74	85	97	110	123	135	146	157	169	181	194	208	219	228	231	229	223	213	204	196	192			
51	56	63	72	82	95	108	123	137	150	163	175	188	201	216	230	243	252	256	254	247	237	227	218	214			
55	61	69	78	90	104	119	135	150	165	179	192	206	220	236	252	266	276	280	278	271	260	249	239	234			
59	66	74	85	98	113	129	146	163	179	194	208	223	238	256	273	288	299	304	302	293	281	268	258	252			
63	70	80	91	105	121	139	157	175	192	208	223	239	256	275	294	310	322	327	324	315	307	288	276	270			
68	76	86	98	113	130	149	169	188	206	223	239	256	275	296	316	334	347	352	349	338	323	308	295	288			
73	82	93	106	122	140	160	181	201	220	238	256	275	296	318	341	360	373	379	375	363	347	331	317	307			
79	89	100	115	132	151	173	194	216	236	256	275	296	318	343	367	388	402	407	403	391	374	356	341	335			
85	96	108	123	142	162	185	208	230	252	273	294	316	341	367	393	415	430	436	431	418	400	382	367	358			
91	102	115	131	150	172	195	219	243	266	288	310	334	360	388	415	438	454	460	459	442	423	404	389	390			
95	106	119	136	155	178	202	226	252	276	299	322	347	373	402	430	454	470	476	472	458	440	420	405	396			
96	107	121	137	157	180	205	231	256	280	304	327	352	379	407	436	460	476	483	479	465	446	426	411	402			
95	106	119	135	155	178	203	229	254	278	302	324	349	375	403	431	455	472	479	474	461	442	422	406	397			
92	102	115	131	150	173	197	223	247	271	293	315	338	363	391	418	442	458	465	461	448	429	409	393	384			
87	97	109	124	143	165	189	213	237	260	281	302	323	347	374	400	423	440	446	442	429	410	390	374	365			
82	91	103	117	136	157	180	204	227	249	268	288	308	331	356	382	404	420	426	422	409	390	370	354	345			
79	87	98	112	130	150	173	196	218	239	258	276	295	317	341	367	389	405	411	406	393	374	354	339	329			
77	85	95	109	126	147	169	192	214	234	252	270	288	309	333	358	380	396	402	397	384	365	345	329	328			

axial dist. = 750.0000 CM OR PRESSURE TIMES 1000.000

TABLE IA
 5.000 WAVELENGTHS
 $k = .04$
 1 Kc, 8" Spacing
 N = 26 M = 36
 50 x 50 Array

33	35	38	41	43	46	50	54	60	67	74	82	89	96	101	105	107	109	111	114	117	120	124	127	128
35	39	42	45	48	51	55	60	66	73	81	89	97	105	110	115	118	120	122	124	127	131	134	137	139
38	42	45	49	52	55	59	64	71	78	87	96	105	113	120	125	128	130	132	135	137	141	144	147	149
41	45	49	52	55	59	63	68	75	84	93	103	112	121	128	134	138	140	142	144	147	150	153	156	158
43	48	52	55	59	63	67	73	80	89	99	109	120	130	137	143	147	150	152	153	156	159	162	165	167
46	51	55	59	63	66	71	77	85	94	105	117	128	139	147	154	158	160	162	164	166	169	172	175	177
50	55	59	63	67	71	76	82	91	101	113	126	139	150	159	166	170	173	174	176	178	181	185	189	190
54	60	64	68	73	77	82	90	99	111	124	138	152	164	174	181	185	188	190	191	194	198	202	206	208
60	66	71	75	80	85	91	99	110	123	137	153	168	181	191	199	204	207	209	211	214	219	224	228	231
67	73	78	84	89	94	101	111	123	137	153	170	186	201	213	221	226	230	232	235	239	244	250	255	258
74	81	87	93	99	105	113	124	137	153	171	190	207	223	236	245	251	255	258	262	266	273	280	285	289
82	89	96	103	109	117	126	138	153	170	190	210	229	246	260	271	277	282	286	290	295	303	310	317	320
89	97	105	112	120	128	139	152	168	186	207	229	250	269	284	295	303	308	312	317	323	331	340	346	350
96	105	113	121	130	139	150	164	181	201	223	246	269	289	305	317	326	332	336	342	348	357	365	373	377
101	110	120	128	137	147	159	174	191	213	236	260	284	305	322	335	345	351	356	362	369	377	386	394	398
105	115	125	134	143	154	166	181	199	221	245	271	295	317	335	349	359	366	371	377	384	392	401	409	413
107	118	128	138	147	158	170	185	204	226	251	277	303	326	345	359	369	376	381	387	394	402	411	419	423
109	120	130	140	150	160	173	188	207	230	255	282	308	332	351	366	376	383	388	393	400	408	417	425	429
111	122	132	142	152	162	174	190	209	232	258	286	312	336	356	371	381	388	392	398	404	413	422	430	434
114	124	135	144	153	164	176	191	211	235	262	290	317	342	362	377	387	393	398	403	410	418	428	436	440
117	127	137	147	156	166	178	194	214	239	266	295	323	348	369	384	394	400	404	410	417	426	436	444	449
120	131	141	150	159	169	181	198	219	244	273	303	331	357	377	392	402	408	413	418	426	436	447	456	461
124	134	144	153	162	172	185	202	224	250	280	310	340	365	386	401	411	417	422	428	436	447	458	468	473
127	137	147	156	165	175	189	206	228	255	285	317	346	373	394	409	419	425	430	436	444	456	468	478	484
128	139	149	158	167	177	190	208	231	258	289	320	350	377	398	413	423	429	434	440	449	461	473	484	490

TABLE IB

1 Kc, 8" Spacing
 M = 36, N = 26
 50 x 50 Array

$k = .04$
 axial dist. $M = 25.0000$ CM OR 0.167 WAVELENGTHS
 PHASE ANGLE $\lambda = 150$ cm.

230	199	170	142	117	96	87	95	100	93	83	77	75	81	93	109	119	120	110	93	79	81	100	121	132
199	167	137	109	84	61	34	252	202	131	55	40	36	41	57	85	106	111	98	66	41	43	79	117	129
170	137	108	83	61	37	215	205	199	197	199	206	218	220	204	186	178	178	184	197	208	207	192	179	173
142	109	83	64	119	196	190	184	181	179	181	184	187	188	186	182	178	178	179	183	186	186	182	177	174
117	84	61	119	189	181	174	169	166	166	167	169	171	172	172	170	168	167	168	170	171	171	170	167	166
96	61	37	196	181	171	163	159	156	156	157	158	160	161	161	160	159	158	159	160	161	161	160	159	158
87	34	215	190	174	163	156	152	149	149	150	151	153	154	154	153	152	152	152	153	154	154	153	152	152
95	252	205	184	169	159	152	147	145	145	145	147	148	149	149	148	147	148	149	149	149	149	149	148	148
100	202	199	181	166	156	149	145	143	143	143	145	146	147	147	146	146	145	146	146	146	147	147	146	146
93	131	197	179	166	156	149	145	143	142	143	145	146	147	147	146	145	145	146	146	147	147	146	146	145
83	55	199	181	167	157	150	145	143	143	144	146	147	148	148	147	146	146	146	146	147	147	146	146	146
77	40	206	184	169	158	151	147	145	145	146	147	149	149	149	148	148	147	148	148	149	149	148	148	147
75	36	218	187	171	160	153	148	146	146	147	149	150	151	151	150	149	149	149	150	151	151	150	149	149
81	41	220	188	172	161	154	149	147	147	148	149	151	152	152	151	150	149	150	151	152	152	151	150	149
93	57	204	186	172	161	154	149	147	147	148	149	151	152	151	150	149	149	150	151	151	152	151	150	149
109	85	186	182	170	160	153	149	146	146	147	148	150	151	150	149	149	148	149	150	151	151	150	149	149
119	106	178	178	168	159	152	148	146	145	146	146	149	150	149	148	147	148	149	150	150	149	148	148	148
120	111	178	178	167	158	152	147	145	145	146	147	149	149	148	147	147	148	149	149	150	149	148	148	148
110	98	184	179	168	159	152	148	146	145	146	148	149	150	149	148	148	148	149	150	150	149	149	149	148
93	66	197	183	170	160	153	149	146	146	147	148	150	151	151	150	149	149	150	150	151	151	150	149	149
79	41	208	186	171	161	154	149	147	147	147	149	151	152	151	151	150	149	150	150	151	151	151	150	149
81	43	207	186	171	161	154	149	147	147	148	149	151	152	152	151	150	150	150	151	151	151	151	150	150
180	79	192	182	170	160	153	149	147	146	147	149	150	151	151	150	149	149	149	150	151	151	150	150	149
121	117	179	177	167	159	152	148	146	146	146	148	149	150	150	149	148	148	149	149	150	150	150	149	148
132	129	173	174	166	158	152	148	146	145	146	147	149	149	149	148	148	148	148	149	149	150	149	148	148

K = .04

TABLE IB

1 Kc, 8" Spacing
M = 36, N = 26
50 x 50 Array

axial dist. M = 50.0000 CM OR
PHASE ANGLE 0.333 WAVELENGTHS
 $\lambda = 150$ cm.

236	204	175	146	117	89	64	54	58	63	63	63	64	69	79	94	104	103	89	72	62	63	76	99	114
204	172	140	107	69	25	-11	-31	-35	-27	-15	-7	-2	0	3	5	5	2	-3	-6	-8	-8	-7	-4	-0
175	140	105	64	11	-36	-63	-77	-82	-80	-74	-67	-61	-59	-60	-65	-70	-72	-70	-66	-64	-64	-66	-71	-75
146	107	64	6	-46	-78	-263	254	249	249	252	257	261	263	262	259	256	255	256	261	261	259	256	254	
117	69	11	-46	-83	255	242	234	230	230	232	235	238	240	239	238	236	235	236	237	239	238	236	235	
89	25	-36	-78	255	238	227	220	217	216	218	220	223	224	224	223	222	221	222	223	224	224	224	223	222
64	-11	-63	263	242	227	217	211	208	207	208	211	213	214	213	212	212	212	213	214	215	214	213	213	
54	-31	-77	254	234	220	211	205	202	202	203	205	207	208	208	207	206	206	207	208	208	208	207	207	
58	-35	-82	249	230	217	208	202	199	199	200	202	204	205	205	204	203	203	203	204	205	205	205	204	204
63	-27	-60	249	230	216	207	202	199	198	199	201	203	204	205	204	203	203	203	204	204	205	205	204	203
63	-15	-74	252	232	218	208	203	200	199	200	202	204	205	206	205	204	204	204	205	205	206	205	205	204
63	-7	-67	257	235	220	211	205	202	201	202	204	206	208	208	207	206	206	207	207	208	207	207	206	206
64	-2	-61	261	238	223	213	207	204	203	204	206	208	210	210	209	208	208	209	210	210	210	209	209	208
69	0	-59	263	240	224	214	208	205	204	205	208	210	211	211	210	209	210	210	210	211	211	211	210	210
79	3	-60	262	239	224	214	208	205	205	206	208	210	211	212	211	210	209	210	211	211	212	211	210	210
94	5	-65	259	238	223	213	208	205	204	205	208	210	211	211	210	209	208	209	210	211	211	211	210	209
104	5	-70	256	236	222	212	207	204	203	205	207	209	210	210	209	208	207	208	209	210	210	210	209	208
103	2	-72	255	235	221	212	206	203	203	204	206	208	209	209	208	207	207	208	209	210	209	209	208	207
89	-3	-70	256	236	222	212	206	203	203	204	206	208	210	210	209	208	207	208	209	210	210	209	208	207
72	-6	-66	259	237	223	213	207	204	204	205	207	209	210	210	209	208	209	210	211	211	210	209	208	207
62	-8	-64	261	239	224	214	208	205	204	205	207	210	211	211	210	209	210	211	211	211	211	211	210	209
63	-8	-64	261	239	224	214	208	205	205	206	208	210	211	212	211	210	210	210	210	211	211	212	211	209
76	-7	-66	259	238	224	214	208	205	204	205	207	209	211	211	210	209	209	210	211	211	211	211	210	209
99	-4	-71	256	236	223	213	207	204	204	205	207	209	210	210	209	208	208	209	210	210	210	210	209	208
114	-0	-75	254	235	222	213	207	204	203	204	206	208	210	210	209	208	207	207	208	209	209	209	208	208

k = .04

TABLE IB

1 Kc, 8" Spacing
M = 36, N = 26
50 x 50 Array

axial dist. = 125.0000 CM OR
PHASE ANGLE

0.633 WAVELENGTHS
 $\lambda = 150$ cm.

-77	254	229	208	192	180	171	164	159	155	153	152	154	150	163	167	169	169	166	163	161	162	165	168	171
254	224	197	174	156	142	133	127	123	120	119	119	120	123	127	131	133	133	130	127	125	126	129	132	134
229	197	168	144	125	111	102	96	93	91	90	90	92	94	98	101	102	102	100	97	96	96	98	101	103
208	174	144	120	101	87	77	72	68	67	66	67	68	71	74	76	77	77	75	73	72	72	74	76	78
192	156	125	101	82	68	59	53	49	48	48	49	50	52	55	57	58	58	57	55	54	54	55	57	58
180	142	111	87	68	54	45	39	35	34	34	35	37	39	41	43	44	44	43	41	40	40	41	43	43
171	133	102	77	59	45	35	29	26	24	25	26	27	29	32	33	34	34	33	32	31	31	31	33	33
164	127	96	72	53	39	29	23	20	18	18	19	21	23	25	27	28	28	27	26	25	25	25	26	27
159	123	93	68	49	35	26	20	16	15	15	16	18	20	22	24	25	25	24	22	22	22	22	23	24
155	120	91	67	48	34	24	18	15	13	13	14	16	18	21	22	23	23	22	21	20	20	21	22	23
153	119	90	66	48	34	25	18	15	13	13	14	16	18	21	22	23	23	22	21	20	20	21	22	23
152	119	90	67	49	35	26	19	16	14	14	15	17	19	22	23	24	24	23	22	21	21	22	23	24
154	120	92	68	50	37	27	21	18	16	16	17	19	21	23	25	26	26	25	24	23	23	24	25	26
158	123	94	71	52	39	29	23	20	18	18	19	21	23	26	27	28	28	27	26	25	25	26	27	28
163	127	98	74	55	41	32	25	22	21	21	22	23	26	28	30	31	31	29	28	27	27	28	29	30
167	131	101	76	57	43	33	27	24	22	22	23	25	27	30	32	33	33	31	30	29	29	30	31	32
169	133	102	77	58	44	34	28	25	23	23	24	26	28	31	33	34	34	32	31	30	30	31	32	33
169	133	102	77	58	44	34	28	25	23	23	24	26	28	31	33	34	34	32	31	30	30	31	32	33
166	130	100	75	57	43	33	27	24	22	22	23	25	27	29	31	32	32	31	30	29	29	30	31	32
163	127	97	73	55	41	32	26	22	21	21	22	24	26	28	30	31	31	31	30	28	27	27	28	31
161	125	96	72	54	40	31	25	22	20	20	21	23	25	27	29	30	30	29	27	27	27	28	29	30
162	126	96	72	54	40	31	25	21	20	20	21	23	25	27	29	30	30	29	27	27	27	28	29	29
165	129	98	74	55	41	31	25	22	21	21	22	24	26	28	30	31	31	31	30	28	28	28	29	30
168	132	101	76	57	43	33	26	23	22	22	23	25	27	29	31	32	32	31	30	29	29	29	30	31
171	134	103	78	58	43	33	27	24	23	23	24	26	28	30	32	33	33	32	31	30	29	29	30	31

k = .04

TABLE IB

axial dist. = 250.0000 CM OR
PHASE ANGLE

1.667 WAVELENGTHS
λ = 150 CM.

1 Kc, 8" Spacing
M = 36, N = 26
50 x 50 Array

160	139	120	102	87	73	63	55	50	47	47	49	51	52	54	56	59	61	64	66	65	63	60	56	54
139	119	100	82	67	54	43	35	30	28	28	29	31	33	35	37	39	41	44	45	45	43	40	37	36
120	100	81	64	49	36	26	18	13	10	10	11	13	15	17	19	21	24	26	27	27	25	23	20	19
102	82	64	48	33	21	11	3	-1	-4	-4	-3	-1	0	2	4	6	8	10	11	11	10	8	6	4
87	67	49	33	19	7	-1	-9	-14	-17	-17	-16	-15	-13	-11	-9	-7	-5	-3	-2	-2	-3	-5	-6	-7
73	54	36	21	7	-3	-13	-20	-25	-27	-28	-27	-26	-24	-22	-20	-18	-16	-14	-13	-13	-14	-16	-17	-18
63	43	26	11	-1	-13	-22	-29	-34	-36	-37	-37	-35	-33	-31	-29	-27	-25	-24	-23	-23	-24	-25	-27	-27
55	35	18	3	-9	-20	-29	-36	-41	-43	-44	-44	-42	-40	-38	-36	-34	-32	-31	-30	-30	-31	-32	-34	-35
50	30	13	-1	-14	-25	-34	-41	-45	-48	-49	-48	-47	-45	-43	-41	-39	-37	-36	-35	-35	-36	-37	-39	-40
47	28	10	-4	-17	-27	-36	-43	-48	-51	-52	-51	-50	-48	-45	-43	-42	-40	-38	-38	-39	-40	-42	-42	-42
47	28	10	-4	-17	-27	-36	-43	-48	-51	-52	-52	-51	-50	-48	-46	-44	-42	-40	-39	-38	-39	-40	-41	-43
49	29	11	-3	-16	-27	-37	-44	-48	-51	-52	-51	-50	-48	-46	-44	-42	-40	-38	-38	-39	-40	-42	-42	-43
51	31	13	-1	-15	-26	-35	-42	-47	-50	-50	-50	-48	-46	-44	-42	-40	-38	-37	-36	-36	-37	-39	-40	-41
52	33	15	0	-13	-24	-33	-40	-45	-48	-48	-46	-44	-42	-40	-38	-36	-34	-33	-32	-32	-33	-34	-36	-37
54	35	17	2	-11	-22	-31	-38	-43	-45	-46	-46	-44	-42	-40	-38	-36	-34	-33	-32	-32	-33	-34	-36	-37
56	37	19	4	-9	-20	-29	-36	-41	-43	-44	-44	-42	-40	-38	-36	-34	-32	-31	-30	-30	-31	-32	-34	-35
59	39	21	6	-7	-18	-27	-34	-39	-42	-42	-42	-40	-38	-36	-34	-32	-30	-29	-28	-28	-29	-31	-32	-33
61	41	24	8	-5	-16	-25	-32	-37	-40	-40	-40	-38	-36	-34	-32	-30	-28	-27	-26	-26	-27	-29	-30	-31
64	44	26	10	-3	-14	-24	-31	-36	-39	-39	-38	-37	-35	-33	-31	-29	-27	-25	-24	-24	-25	-27	-29	-30
66	45	27	11	-2	-13	-23	-30	-35	-38	-38	-38	-36	-34	-32	-30	-28	-26	-24	-23	-23	-25	-27	-29	-29
65	45	27	11	-2	-13	-23	-30	-35	-38	-39	-38	-36	-34	-32	-30	-28	-26	-24	-23	-24	-25	-27	-29	-29
63	43	25	10	-3	-14	-24	-31	-36	-39	-40	-39	-37	-35	-33	-31	-29	-27	-26	-25	-25	-26	-28	-29	-30
60	40	23	8	-5	-16	-25	-32	-37	-40	-41	-40	-39	-37	-34	-32	-31	-29	-27	-27	-27	-28	-29	-31	-31
56	37	20	6	-6	-17	-27	-34	-39	-42	-43	-42	-40	-38	-36	-34	-32	-30	-29	-28	-28	-29	-31	-32	-33
54	36	19	4	-7	-18	-27	-35	-40	-42	-43	-43	-41	-39	-37	-35	-33	-31	-30	-29	-29	-30	-31	-33	-33

$k = .04$
 TABLE IB
 1 Kc, 8" Spacing
 $M = 36, N = 26$
 50 x 50 Array
 $\lambda = 150$ cm.
 3.333 WAVELENGTHS
 axial dist. Mc 500.0000 CM OR PHASE ANGLE

-33	-44	-54	-63	-72	-80	-87	265	260	256	254	253	254	256	258	260	261	262	263	264	266	268	-89	-87	-85
-44	-56	-66	-75	-84	267	260	253	248	244	242	241	242	244	246	248	249	250	251	253	254	256	259	261	262
-54	-66	-76	-85	265	257	250	243	238	234	232	231	232	234	236	237	239	240	241	242	244	246	249	251	252
-63	-75	-85	264	256	248	241	234	229	225	223	222	223	225	226	228	230	231	232	233	235	238	240	242	243
-72	-84	265	247	240	233	226	221	217	215	214	215	216	218	220	221	222	224	225	227	229	232	234	235	
-80	267	248	240	232	225	219	214	210	208	207	207	208	210	212	213	215	216	218	220	222	224	226	228	
-87	260	250	241	233	225	218	212	207	203	201	200	200	201	203	205	206	208	209	211	213	215	217	219	220
265	253	243	234	226	219	212	206	201	197	195	194	194	195	197	199	200	202	203	205	207	209	211	213	214
260	248	238	229	221	214	207	201	196	192	190	189	189	190	192	194	195	197	198	200	202	203	205	207	208
256	244	234	225	217	210	203	197	192	188	186	185	185	186	188	190	192	193	195	196	198	199	201	203	204
254	242	232	223	215	208	201	195	190	186	183	182	183	184	186	188	189	191	192	194	195	197	199	200	201
253	241	231	222	214	207	200	194	189	185	182	181	182	183	185	187	189	190	192	193	194	196	198	199	200
254	242	232	223	215	207	200	194	189	185	183	182	182	184	186	188	189	191	192	193	195	197	199	200	201
256	244	234	225	216	208	201	195	190	186	184	183	184	185	187	189	190	192	193	195	196	198	200	202	203
258	246	236	226	218	210	203	197	192	188	186	185	186	187	189	191	192	193	195	196	198	200	202	204	205
260	248	237	228	220	212	205	199	194	190	188	187	188	189	191	192	194	195	196	198	200	202	204	206	207
261	249	239	230	221	213	206	200	195	192	189	189	190	192	194	195	197	198	200	201	203	206	208	209	210
262	250	240	231	222	215	208	202	197	193	191	190	191	192	193	195	197	198	199	201	203	205	207	209	210
263	251	241	232	224	216	209	203	198	195	192	192	192	193	195	196	198	199	201	202	204	206	208	210	211
264	253	242	233	225	218	211	205	200	196	194	193	193	195	196	198	200	201	202	204	206	208	210	212	213
266	254	244	235	227	220	213	207	202	198	195	194	195	196	198	200	201	203	204	206	207	209	211	213	214
268	256	246	238	229	222	215	209	203	199	197	196	197	198	200	202	203	205	206	208	209	211	213	215	216
-89	259	249	240	232	224	217	211	205	201	199	198	199	200	202	204	206	207	208	210	211	213	215	217	218
-87	261	251	242	234	226	219	213	207	203	200	199	200	202	204	206	208	209	210	212	213	215	217	219	220
-85	262	252	243	235	228	220	214	208	204	201	200	201	203	205	207	209	210	211	213	214	216	218	220	220

k = .04

TABLE IB

1 Kc, 8" Spacing
M = 36, N = 26
50 x 50 Array

axial dist. = 750.0000 CM OR 5.000 WAVELENGTHS
PHASE ANGLE λ = 150 CM.

104	173	163	155	148	143	139	136	134	131	129	127	124	123	122	121	122	124	127	131	134	136	141	143	144
173	162	152	143	136	131	127	124	122	120	118	115	113	112	110	110	111	113	116	119	123	126	129	131	132
163	152	142	133	126	120	116	113	111	109	107	105	103	102	101	100	101	103	105	109	112	116	119	121	122
155	143	133	124	117	111	107	104	102	100	99	97	95	93	92	92	94	96	100	104	107	110	112	113	
148	136	126	117	109	104	100	97	95	93	92	90	88	86	84	83	81	80	79	80	81	84	87	91	95
143	131	120	111	104	98	94	92	90	88	86	84	83	81	79	77	76	75	76	77	80	83	87	91	94
139	127	116	107	100	94	90	88	86	84	83	81	79	77	76	75	76	77	80	83	87	91	94	97	98
136	124	113	104	97	92	88	85	84	82	80	78	76	74	73	72	73	74	77	80	85	88	92	94	95
134	122	111	102	95	90	86	84	82	80	78	76	73	72	70	70	72	75	78	82	86	90	92	93	
131	120	109	100	93	88	84	82	80	78	76	73	71	69	68	68	70	73	76	81	84	88	90	91	
129	118	107	99	92	86	83	80	78	76	74	71	69	67	66	66	68	71	75	79	82	86	88	89	
127	115	105	97	90	84	81	78	76	73	71	69	67	65	64	64	66	69	72	76	80	83	86	87	
124	113	103	95	88	83	79	76	73	71	69	67	65	63	62	62	64	67	70	74	78	81	83	84	
123	112	102	93	86	81	77	74	72	69	67	65	63	61	60	60	61	63	65	69	73	76	79	81	82
122	110	101	92	85	80	76	73	70	68	66	64	62	60	59	59	60	61	64	68	71	75	78	80	81
121	110	100	92	85	79	75	72	70	68	66	64	62	60	59	59	61	64	67	71	74	77	80	81	
122	111	101	92	85	80	76	73	70	68	66	64	62	61	60	59	60	62	64	68	72	75	78	80	81
124	113	103	94	87	81	77	74	72	70	68	66	64	63	61	61	62	63	66	69	73	77	80	82	83
127	116	105	96	89	84	80	77	75	73	71	69	67	65	64	64	66	69	72	76	80	83	85	86	
131	119	109	100	93	87	83	80	78	76	75	72	70	69	68	67	68	69	72	76	79	83	86	89	90
134	123	112	104	96	91	87	85	82	81	79	76	74	73	71	71	72	73	76	79	83	87	90	93	94
138	126	116	107	100	95	91	88	86	84	82	80	78	76	75	74	75	77	80	83	87	91	94	97	98
141	129	119	110	103	98	94	92	90	88	86	83	81	79	78	77	78	80	83	86	90	94	97	100	101
143	131	121	112	105	100	97	94	92	90	88	86	83	81	80	80	82	85	89	93	97	100	102	103	
144	132	122	113	106	101	98	95	93	91	89	87	84	82	81	81	81	83	86	90	94	98	101	103	102

f = 3 kc, m = 36, n = 26, d = 20 cm.
k = .1257
 $\lambda = 50$ cm.

TABLE 2A
FIELD IN
QUADRANT NO. 2
axial dist. = 750.0000 CM OR 15.000 WAVELENGTHS
PRESSURE TIMES 1000.000

2	2	3	4	4	6	7	8	9	11	12	13	15	15	16	16	16	16	16	15	15	15	15	15	15	15	15
2	3	4	5	6	7	9	10	12	14	16	17	19	20	21	21	21	20	20	20	19	19	20	20	20	20	20
3	4	5	6	8	9	11	13	16	18	20	22	24	25	26	27	26	26	25	25	25	25	25	25	25	25	25
4	5	6	8	10	12	14	17	20	22	25	28	30	32	33	33	33	33	32	31	31	31	31	31	31	32	32
4	6	8	10	12	15	18	21	24	28	31	35	37	39	41	41	41	41	40	40	39	38	39	39	39	39	
6	7	9	12	15	18	22	25	30	34	38	42	45	48	50	50	50	50	49	48	47	47	47	47	47	48	
7	9	11	14	18	22	26	31	36	41	46	50	54	58	59	60	60	59	58	57	56	56	56	57	57	57	
8	10	13	17	21	25	31	36	42	48	54	60	64	68	70	71	71	70	68	67	66	67	67	67	67	68	
9	12	16	20	24	30	36	42	49	56	63	69	75	79	82	83	82	81	79	78	77	77	77	78	78	79	
11	14	18	22	28	34	41	48	56	64	72	79	85	90	93	95	94	93	91	89	88	88	89	89	89	90	
12	16	20	25	31	38	46	54	63	72	81	89	96	101	105	106	106	104	102	100	99	99	100	100	101	101	
13	17	22	28	35	42	50	60	69	79	89	98	106	112	115	117	116	114	112	110	109	109	110	111	111	111	
15	19	24	30	37	45	54	64	75	85	96	106	114	120	125	126	126	123	121	119	118	118	119	119	120	120	
15	20	25	32	39	48	58	68	79	90	101	112	120	127	132	133	133	130	128	125	124	124	125	125	126	126	
16	21	26	33	41	50	59	70	82	93	105	115	125	132	136	138	137	135	132	130	129	129	130	130	131	131	
16	21	27	33	41	50	60	71	83	95	106	117	126	133	138	140	139	137	134	131	130	130	131	131	132	132	
16	21	26	33	41	50	60	71	82	94	106	116	126	133	137	139	138	136	133	131	130	130	131	131	131	132	
16	20	26	33	40	49	59	70	81	93	104	114	123	130	135	137	136	134	131	129	127	128	128	129	130	130	
15	20	25	32	40	48	58	68	79	91	102	112	121	128	132	134	133	131	128	126	125	125	125	126	126	127	
15	20	25	31	39	47	57	67	78	89	100	110	119	125	130	131	131	129	126	124	123	123	123	124	124	125	
15	19	25	31	38	47	56	66	77	88	99	109	118	124	129	130	130	127	125	123	122	122	122	123	123	124	
15	19	25	31	39	47	56	67	77	88	99	109	118	124	129	130	130	126	125	123	122	122	123	123	123	124	
15	20	25	31	39	47	57	67	78	89	100	110	119	125	130	131	131	128	126	124	122	122	123	123	124	124	
15	20	25	31	39	47	57	67	78	89	100	110	119	125	130	131	131	128	126	124	123	123	123	124	124	125	
15	20	25	32	39	47	57	67	78	89	100	111	119	126	130	132	131	129	126	124	123	123	124	124	125	125	
15	20	25	32	39	47	57	67	78	89	101	111	120	126	131	132	132	130	127	125	124	124	124	125	125	126	

k = .1257, f = 3 kc, m = 36, n = 26

d = 20 cm.



axial dist. M = 25.0000 CM OR 0.500 WAVELENGTHS

-50	-72	-58	-68	-69	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71	-71
-72	-75	-68	-74	-75	-76	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78	-78
-58	-68	-69	-74	-76	-78	-79	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
-69	-74	-74	-79	-80	-82	-83	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84	-84
-68	-75	-76	-80	-83	-84	-86	-86	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87	-87
-69	-76	-78	-82	-84	-86	-87	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88	-88
-71	-78	-79	-83	-86	-87	-89	-89	269	269	269	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89
-71	-78	-80	-84	-86	-88	-89	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	268	268	268	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	268	268	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	268	268	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269
-71	-78	-80	-84	-87	-88	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269	269

NOTE: -89° = 271°

271 271 ETC

$k = .1257$, $f = 3$ kc, $m = 36$, $n = 26$
 $d = 20$ cm.

PHASE OF
FIELD IN
QUADRANT NO. 2
 $\lambda = 50$ cm.

axial dist. $M = 500.0000$ CM OR 10.000 WAVELENGTHS
PHASE ANGLE

-52	-76	256	238	223	210	201	194	190	186	186	189	191	193	196	197	198	198	198	197	197	197	197
-76	254	231	212	196	184	175	168	164	162	162	163	165	167	169	171	172	172	171	171	171	171	171
256	231	208	189	174	161	152	146	142	140	140	141	143	145	147	148	149	149	149	149	149	149	149
238	212	189	170	155	142	133	127	123	121	121	122	124	126	128	130	130	130	130	130	130	130	130
223	196	174	155	139	127	118	111	107	106	105	106	108	111	113	114	115	115	114	114	114	114	114
210	184	161	142	127	115	106	99	95	93	93	94	96	98	100	102	103	103	102	102	102	102	102
201	175	152	133	118	106	96	90	86	84	84	85	87	89	91	93	94	94	93	93	93	93	93
194	168	146	127	111	99	90	84	80	78	78	79	81	83	85	86	87	87	87	87	87	87	87
190	164	142	123	107	95	86	80	76	74	74	75	77	79	81	82	83	83	83	83	83	83	83
188	162	140	121	106	93	84	78	74	72	72	73	75	77	79	81	81	81	81	81	81	81	81
186	162	140	121	105	93	84	78	74	72	72	73	75	77	79	80	81	81	81	81	81	81	81
189	163	141	122	106	94	85	79	75	73	73	74	76	78	80	81	82	82	82	82	82	82	82
191	165	143	124	108	96	87	81	77	75	75	76	78	80	82	83	84	84	84	84	83	83	84
193	167	145	126	111	98	89	83	79	77	77	78	80	82	84	85	86	86	86	86	86	86	86
196	169	147	128	113	100	91	85	81	79	79	80	82	84	86	87	88	88	88	88	88	88	88
197	171	148	130	114	102	93	86	82	81	80	81	83	85	87	89	90	90	90	90	90	90	90
198	172	149	130	115	103	94	87	83	81	81	82	84	86	88	90	91	91	90	90	90	90	90
198	172	149	130	115	103	94	87	83	81	81	82	84	86	88	90	91	91	90	90	90	90	90
198	171	149	130	115	102	93	87	83	81	81	82	84	86	88	90	90	90	90	90	90	90	90
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	90	90
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89
197	171	149	130	114	102	93	87	83	81	81	82	84	86	88	89	90	90	90	89	89	89	89

axial dist. $M = 500.0000$ $CW OR$ 20.000 **TABLE 3A** 6 $Kcps$ $\lambda = 25$ $cm.$
 PRESSURE TIMES, 10000.000 WAVELENGTHS

0	0	0	1	2	4	5	7	9	10	11	12	12	13	13	13	12	12	12	12	12	12	12	12	12
0	1	1	3	5	8	11	14	17	20	23	24	25	25	25	25	25	25	25	25	25	25	25	25	25
0	1	3	6	9	14	20	26	32	38	42	45	46	47	47	47	47	47	47	47	47	47	47	47	47
1	3	6	10	17	25	35	46	56	66	73	78	81	82	82	81	81	81	81	81	81	81	81	81	81
2	5	9	17	27	40	56	74	91	106	117	125	130	131	131	131	131	131	131	131	131	131	131	131	131
4	8	14	25	40	60	84	110	135	158	175	187	194	196	196	196	195	195	195	195	195	195	195	195	195
5	11	20	35	56	84	118	153	188	220	244	260	269	273	273	272	271	271	271	271	271	271	271	271	271
7	14	26	46	74	110	153	200	246	286	318	339	341	356	356	355	354	354	354	354	354	354	354	354	354
9	17	32	56	91	135	188	246	302	352	391	417	432	437	437	436	435	434	434	434	434	434	434	434	434
10	20	38	66	106	158	220	286	352	410	455	486	503	509	510	508	507	506	506	506	506	506	506	506	506
11	23	42	73	117	175	244	318	391	455	505	539	558	565	566	564	563	562	562	562	562	562	562	562	562
12	24	45	78	125	187	260	339	417	486	539	575	596	603	604	602	600	599	599	599	599	599	599	599	599
12	25	46	81	130	194	269	351	432	503	558	596	617	624	625	623	621	621	620	621	620	621	620	621	620
13	25	47	82	131	196	273	356	437	509	565	603	624	632	633	631	629	628	628	629	628	629	628	629	628
13	25	47	82	131	196	273	356	437	510	566	604	625	633	633	632	630	629	629	629	629	629	629	629	629
12	25	47	82	131	196	272	355	436	508	564	602	623	631	632	630	628	627	627	627	627	627	627	627	627
12	25	47	81	131	195	271	354	435	507	563	600	621	629	630	628	626	625	625	625	625	625	625	625	625
12	25	47	81	131	195	271	354	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	354	434	506	562	600	621	629	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	354	434	506	562	600	621	629	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624
12	25	47	81	131	195	271	353	434	506	562	600	621	628	629	627	625	624	624	624	624	624	624	624	624

axial dist. H = 750.0000 CW OR
 PRESSURE TIMES 10000.000

TABLE 3A
 30.000 WAVELENGTHS
 6 Kcps $\lambda = 25$ cm.

1	1	2	4	6	8	11	14	17	20	23	25	26	27	27	26	26	26	26	26	26	26	26
1	3	4	7	10	14	19	24	29	34	38	41	43	44	44	44	43	43	43	43	43	43	43
2	4	7	11	17	23	30	39	47	54	61	66	69	71	71	70	70	69	69	69	69	69	69
4	7	11	17	25	35	46	59	71	82	92	100	105	107	107	106	106	105	105	105	105	105	105
6	10	17	25	37	51	67	85	102	119	134	144	151	154	155	154	153	152	152	152	152	152	152
8	14	23	35	51	70	93	117	141	165	184	199	209	213	214	213	211	210	210	210	210	210	210
11	19	30	46	67	93	122	154	186	217	243	263	275	281	282	280	278	276	276	276	276	276	276
14	24	39	59	85	117	154	195	235	274	306	331	347	354	356	353	351	349	348	349	349	349	349
17	29	47	71	102	141	186	235	284	331	370	400	420	428	430	427	424	422	421	421	421	422	422
20	34	54	82	119	165	217	274	331	384	430	465	488	498	500	497	493	490	490	490	490	490	490
23	38	61	92	134	184	243	306	370	430	482	521	546	557	559	556	552	549	548	548	549	549	549
25	41	66	100	144	199	263	331	400	465	521	563	590	603	605	601	596	593	593	593	593	593	593
26	43	69	105	151	209	275	347	420	488	546	590	619	632	634	630	625	622	621	621	622	622	622
27	44	71	107	154	213	281	354	428	498	557	603	632	645	647	643	638	635	634	634	635	635	635
27	44	71	107	155	214	282	356	430	500	559	605	634	647	649	645	640	637	636	637	637	637	637
26	44	70	106	154	213	280	353	427	497	556	601	630	643	645	641	636	633	632	632	633	633	633
26	44	70	106	153	211	278	351	424	493	552	596	625	638	640	636	631	628	627	627	628	628	628
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	348	421	490	548	593	621	634	636	632	627	624	623	623	624	624	624
26	43	69	105	152	210	276	348	421	490	548	593	621	634	636	632	627	624	623	623	624	624	624
26	43	69	105	152	210	276	349	422	490	549	593	622	634	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625
26	43	69	105	152	210	276	349	422	490	549	593	622	635	637	633	628	625	624	624	625	625	625

TABLE 4A

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. in	M = 50.0000 CM OR	3.000	WAVELENGTHS
PRESSURE	TIMES	1000.000	
0	0	1	2 3 5 7 9 10 11 12 12 12 12 12 12 12 12 12
0	0	1	2 4 6 9 12 15 18 20 21 21 22 22 22 22 22 22 22
0	1	2	4 6 10 15 20 25 29 31 33 34 35 35 35 36 36 35 36
1	2	4	6 11 16 23 30 36 42 46 49 51 52 53 53 53 53 53 53
2	4	6	11 16 24 32 41 50 57 63 67 70 72 73 74 74 74 74 74
3	6	10	16 24 33 44 55 65 75 82 88 92 95 97 98 99 99 99 99 99
5	9	15	23 32 44 56 69 82 93 103 110 116 121 124 125 126 126 126 126 126
7	12	20	30 41 55 69 84 99 112 124 134 141 147 151 153 154 154 154 154 154
9	15	25	36 50 65 82 99 116 131 145 156 166 173 178 180 181 182 181 181 181 181
10	18	29	42 57 75 93 112 131 148 164 177 188 196 202 205 206 206 206 206 206 206
11	20	31	46 63 82 103 124 145 164 181 195 207 217 223 226 227 227 227 227 227 227
12	21	33	49 67 88 110 134 156 177 195 211 224 233 240 243 245 245 245 245 245 245
12	21	34	51 70 92 116 141 166 188 207 224 237 247 254 257 259 259 258 258 259 259
12	22	35	52 72 95 121 147 173 196 217 233 247 257 264 268 269 269 269 269 269 269
12	22	35	53 73 97 124 151 178 202 223 240 254 264 271 274 276 276 276 276 276 276
12	22	35	53 74 98 125 153 180 205 226 243 257 268 274 278 279 279 279 279 279 279
12	22	36	53 74 99 126 154 181 206 227 245 259 269 276 279 281 281 281 281 281 281
12	22	36	53 74 99 126 154 182 206 227 245 259 269 276 279 281 281 281 281 281 281
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 280 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 259 269 276 279 281 281 281 281 281 281
12	22	36	53 74 99 126 154 181 206 227 245 259 269 276 279 281 281 280 280 281 281
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 281 281
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 280 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 280 281 280 280 280 280
12	22	35	53 74 99 126 154 181 206 227 245 258 269 276 279 281 281 280 280 280 280
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 280 281 280 280 280 280
12	22	36	53 74 99 126 154 181 206 227 245 258 269 276 279 280 281 280 280 280 280

TABLE 4A

9 Kc, 8" Spacing
N = 20, M = 36
50 x 50 Array

axial dist. M= 125.0000 CM OR 7.500 WAVELENGTHS
PRESSURE TIMES 1000.000

0	1	2	5	10	16	27	37	46	53	59	62	63	64	64	64	64	64	64	64
1	2	3	7	12	20	30	40	50	58	64	67	69	69	70	70	70	70	70	70
2	3	5	9	15	23	33	44	54	62	68	71	73	74	75	75	76	76	77	77
5	7	9	13	18	26	37	48	58	66	72	76	78	79	80	80	81	82	83	84
10	12	15	18	24	32	42	53	63	71	77	81	83	84	86	87	89	91	92	94
18	20	23	26	32	40	50	60	70	78	83	87	90	92	94	97	99	102	105	107
27	30	33	37	42	50	59	69	78	86	92	96	99	102	105	108	112	116	120	124
37	40	44	48	53	60	69	79	88	95	101	105	108	112	116	121	126	131	137	142
46	50	54	58	63	70	78	88	96	104	109	113	117	122	127	132	139	145	152	158
53	58	62	66	71	78	86	95	104	111	116	120	125	130	135	142	149	157	165	172
59	64	68	72	77	83	92	101	109	116	121	126	131	136	142	149	157	166	174	182
62	67	71	76	81	87	96	105	113	120	126	131	136	141	148	155	163	172	181	189
63	69	73	78	83	90	99	108	117	125	131	136	141	146	153	161	169	178	187	196
64	69	74	79	84	92	102	112	122	130	136	141	146	152	159	167	175	185	194	202
64	70	75	80	86	94	105	116	127	135	142	148	153	159	166	174	182	192	201	210
64	70	75	80	87	97	108	121	132	142	149	155	161	167	174	182	191	200	209	218
64	70	75	81	89	99	112	126	139	149	157	163	169	175	182	191	200	209	218	227
64	70	76	82	91	102	116	131	145	157	166	172	178	185	192	200	209	219	228	237
64	70	76	83	92	105	120	137	152	165	174	181	187	194	201	209	218	228	238	246
64	70	77	84	94	107	124	142	158	172	182	189	196	202	210	218	227	237	246	255
64	71	77	84	95	109	127	145	163	177	188	196	202	209	216	225	234	243	253	262
64	71	77	85	96	110	128	148	166	181	192	200	207	213	221	229	238	248	257	266
64	71	77	85	96	111	129	149	168	183	194	202	209	215	223	231	240	249	259	268
64	70	77	85	96	111	129	149	168	183	194	203	209	216	223	231	240	250	259	268
64	70	77	85	96	111	129	149	168	183	194	203	209	216	223	231	240	250	259	268

TABLE 4A

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist.	M=	250.0000	CM OR	15.000	WAVELENGTHS																			
1	2	4	8	14	22	32	43	53	62	69	73	75	75	75	75	75	75	75	75	75	75	75	75	
2	3	5	9	15	23	33	44	54	63	69	73	75	76	76	76	76	76	76	76	76	76	76	76	76
4	5	7	11	17	25	35	46	56	65	71	75	77	78	78	78	78	78	78	78	78	78	78	78	78
8	9	11	15	21	29	39	49	60	68	74	78	80	81	82	82	82	82	82	82	82	82	82	82	82
14	15	17	21	27	35	45	56	66	74	80	84	86	87	88	88	88	88	88	88	88	88	88	88	88
22	23	25	29	35	43	53	64	74	82	88	92	94	95	96	97	97	97	97	97	97	97	97	97	97
32	33	35	39	45	53	63	74	84	92	98	101	104	105	106	107	107	107	107	107	107	107	107	107	107
43	44	46	49	56	64	74	84	94	102	108	111	114	115	117	118	118	117	115	113	110	108	107	106	105
53	54	56	60	66	74	84	94	104	111	117	120	123	125	126	128	128	128	127	125	122	119	116	114	113
62	63	65	68	74	82	92	102	111	119	124	128	130	132	134	136	136	135	132	129	125	122	120	118	118
69	69	71	74	80	88	98	108	117	124	129	133	135	138	140	141	142	141	138	134	130	126	124	122	122
73	73	75	78	84	92	101	111	120	128	133	136	139	141	143	145	146	144	142	138	133	129	127	125	124
75	75	77	80	86	94	104	114	123	130	135	139	141	144	146	148	148	147	144	140	136	132	129	127	127
75	76	78	81	87	95	105	115	125	132	138	141	144	146	148	150	151	150	147	143	138	134	131	130	129
75	76	78	82	88	96	106	117	126	134	140	143	146	148	151	153	153	152	149	145	141	137	134	132	131
75	76	78	82	88	97	107	118	128	136	141	145	148	150	153	154	155	154	151	147	143	139	136	134	133
75	76	78	82	88	97	107	118	128	136	142	146	148	151	153	155	156	155	152	148	143	139	136	135	134
75	76	78	82	88	96	106	117	127	135	141	144	147	150	152	154	155	154	151	147	143	139	136	134	133
75	76	78	82	88	96	105	115	125	132	138	142	144	147	149	151	152	151	148	144	140	136	133	131	130
75	76	78	81	87	94	103	113	122	129	134	138	140	143	145	147	148	147	144	141	136	132	129	127	126
75	76	78	81	86	93	101	110	119	125	130	133	136	138	141	143	143	143	140	136	132	127	124	122	122
75	76	78	81	85	92	100	108	116	122	126	129	132	134	137	139	139	139	136	132	127	123	120	118	118
75	76	77	80	85	91	99	107	114	120	124	127	129	131	134	136	136	136	133	129	124	120	117	115	115
75	76	77	80	85	91	98	106	113	118	122	125	127	130	132	134	135	134	131	127	122	118	115	114	113
75	76	77	80	84	91	98	105	112	118	122	124	127	129	131	133	134	133	130	126	122	118	115	113	112

TABLE 4A

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. M = 375.0000 CM OR 22.500 WAVELENGTHS
 PRESSURE TIMES 10000.000

24	37	59	95	150	225	315	414	511	596	661	704	727	735	736	733	732	731	730	731	731	731	731	732	732	732
37	53	78	115	171	246	338	439	538	625	691	734	756	763	762	758	754	752	751	750	750	750	750	751	752	752
59	78	107	150	210	289	383	487	589	677	744	787	808	812	808	801	795	790	786	784	782	782	782	783	784	
95	115	150	201	268	353	452	560	665	755	821	863	881	882	874	863	852	843	835	829	825	823	823	824	825	
150	171	210	268	343	436	543	656	763	854	920	958	972	968	955	938	922	908	895	884	876	871	870	870	871	
225	246	289	353	436	538	651	769	879	970	1033	1067	1076	1066	1047	1024	1001	980	960	943	930	922	918	918	918	
315	338	383	452	543	651	772	893	1005	1094	1153	1182	1183	1167	1140	1101	1081	1052	1025	1001	982	969	962	961	961	
414	439	487	560	656	769	893	1017	1128	1214	1267	1288	1283	1258	1225	1187	1150	1114	1079	1047	1021	1004	994	992	992	
511	538	589	665	763	879	1005	1128	1236	1317	1363	1376	1362	1330	1289	1245	1200	1156	1114	1075	1043	1020	1008	1004	1004	
596	625	677	755	854	970	1094	1214	1317	1390	1429	1434	1412	1372	1325	1274	1223	1172	1123	1078	1040	1014	1000	995	994	
661	691	744	821	920	1033	1153	1267	1363	1429	1459	1456	1428	1382	1329	1273	1217	1162	1108	1058	1016	987	971	965	965	
704	734	787	863	958	1067	1182	1288	1376	1456	1474	1412	1363	1306	1247	1188	1129	1072	1019	975	943	926	919	919	919	
727	756	808	881	972	1076	1183	1283	1362	1428	1456	1412	1374	1322	1263	1203	1143	1083	1025	970	924	891	872	865	864	
735	763	812	882	968	1066	1167	1258	1328	1372	1363	1322	1268	1210	1150	1090	1031	973	918	871	837	817	809	807	807	
736	762	808	874	955	1047	1140	1225	1289	1329	1329	1306	1263	1210	1152	1093	1035	978	921	867	820	785	763	754	751	
733	758	801	863	938	1024	1101	1182	1245	1274	1273	1247	1203	1150	1093	1037	982	927	872	819	772	735	713	702	698	
732	754	795	852	922	1001	1081	1150	1200	1223	1217	1188	1143	1090	1035	982	929	877	824	772	726	689	664	652	647	
731	752	790	843	908	980	1052	1114	1156	1172	1162	1129	1083	1031	978	927	877	827	776	726	680	643	617	603	597	
730	751	786	835	895	960	1025	1083	1123	1156	1141	1108	1072	1025	973	921	872	824	776	728	679	634	596	569	548	
731	750	784	829	884	943	1001	1047	1078	1094	1078	1058	1019	970	918	867	819	772	726	679	632	588	549	522	498	
731	750	782	825	876	930	982	1021	1043	1040	1016	975	924	871	820	772	726	680	634	588	543	505	477	460	453	
731	750	782	823	871	922	969	1004	1014	987	943	891	837	785	735	689	643	596	549	505	467	439	422	415	415	
732	751	782	823	870	918	962	994	1008	1000	971	926	872	817	763	713	664	617	569	522	477	439	411	395	388	
732	752	783	824	870	918	961	992	1004	995	965	919	865	809	754	702	652	603	554	505	460	422	395	380	374	
732	752	784	825	871	918	961	992	1004	994	965	919	864	807	751	698	647	597	548	498	453	415	388	374	368	

TABLE 4A

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. M = 500.0000 CM OR PRESSURE TIMES 10000.000	30.000	WAVELENGTHS
37 49 69 100 145 206 278 358 437 510 570 613 638 650 652 650 647 645 645 645 645 645 645 645		
49 61 78 104 141 191 254 323 393 458 511 550 573 584 587 585 583 582 581 581 581 581 581 581		
69 78 94 115 144 183 232 288 346 400 445 478 498 508 511 511 510 509 509 509 508 508 508 508		
100 104 115 132 154 182 216 256 298 338 372 397 413 421 424 425 425 426 426 425 425 425 425 425		
145 141 144 154 169 187 208 231 255 278 298 312 321 326 328 330 332 333 334 335 334 334 334 334		
206 191 183 182 187 196 206 215 224 232 237 239 239 237 236 237 239 242 245 246 245 244 244 244		
278 254 232 216 208 206 208 212 216 217 215 210 201 191 183 178 178 181 184 187 187 187 186 186		
358 323 288 256 231 215 212 219 230 240 246 245 237 225 211 200 193 192 194 197 199 200 200 199 199		
437 393 346 298 255 224 216 230 256 284 304 314 313 304 290 275 264 259 259 261 264 265 265 265 265		
510 458 400 338 278 232 217 240 284 329 365 386 392 386 373 356 342 334 333 335 337 339 339 339		
570 511 445 372 298 237 215 246 304 365 413 443 455 453 440 423 407 397 394 396 398 400 401 401 400		
613 550 478 397 312 239 210 245 314 386 443 480 497 498 486 469 452 441 437 438 440 442 443 443 443		
638 573 498 413 321 239 201 237 313 392 455 497 518 521 510 493 476 464 459 460 462 465 466 465 465		
650 584 508 421 326 237 191 225 304 386 453 498 521 525 516 499 482 470 465 465 467 469 470 470 470		
652 587 511 424 328 236 183 211 290 373 440 486 510 516 508 492 475 462 457 456 459 461 462 462 462		
650 585 511 425 330 237 178 200 275 356 423 469 493 499 492 477 460 448 442 441 443 446 447 447 446		
647 583 510 425 332 239 178 193 264 342 407 452 476 482 475 460 444 431 425 424 427 429 430 430 430		
645 582 509 426 333 242 181 192 259 334 397 441 464 470 462 448 431 419 413 412 414 416 418 418 417		
645 582 509 426 334 245 184 194 259 333 394 437 459 465 457 442 425 413 407 406 409 411 412 412 412		
645 581 509 426 335 246 187 197 261 335 396 438 460 465 456 441 424 412 406 406 408 410 412 411 411		
645 581 509 425 334 245 187 199 264 337 398 440 462 467 459 443 427 414 409 408 410 413 414 414 413		
645 581 508 425 334 245 187 200 265 339 400 442 465 469 461 446 429 416 411 410 413 415 416 416 416		
645 581 508 425 334 244 187 200 265 339 401 443 466 470 462 447 430 418 412 412 414 416 417 417 417		
645 581 508 425 334 244 186 199 265 339 401 443 465 470 462 447 430 418 412 411 414 416 417 417 417		
645 581 508 425 334 244 186 199 265 339 400 443 465 470 462 446 430 417 412 411 413 416 417 417 416		

TABLE 4B

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. M = 250.0000 CM OR	15.000	WAVELENGTHS
PHASE ANGLE		
-76	266	245 227 214 204 198 194 192 191 192 193 194 194 195 195 195 195 195 195 195 195 195 195
266	258	244 229 216 206 199 194 192 191 192 193 194 194 195 195 195 195 195 195 195 195 195 195
245	244	237 227 216 207 199 195 193 192 192 193 194 195 195 195 195 195 195 195 195 195 195 195
227	229	227 222 214 206 199 195 192 192 192 193 193 194 195 195 194 194 194 194 194 194 194 194
214	216	216 214 209 203 198 193 191 190 190 191 192 193 193 193 193 192 192 192 192 192 192 192
204	206	207 206 203 199 194 190 188 187 187 188 189 190 190 190 189 189 188 188 189 189 189 190
198	199	199 198 194 190 187 185 184 184 185 186 186 186 186 185 184 184 184 184 185 185 186 186
194	194	195 195 193 190 187 183 181 180 180 181 182 183 183 182 181 180 180 179 180 180 181 182
192	192	193 192 191 188 185 181 179 178 178 179 180 180 180 179 178 177 176 176 176 177 178 179
191	191	192 192 190 187 184 180 178 176 176 177 178 178 178 178 177 176 175 174 174 174 175 176 177
192	192	192 192 190 187 184 180 178 176 176 177 178 178 178 178 178 176 175 174 174 174 175 176 177
193	193	193 193 191 188 185 181 178 177 177 177 178 179 179 178 177 176 175 174 174 174 175 176 177
194	194	194 193 192 189 186 182 179 178 178 178 179 180 180 179 178 176 175 175 175 176 176 177 178
194	194	195 194 193 190 186 183 180 178 178 179 180 180 180 180 178 177 176 176 176 176 177 178 179
195	195	195 195 193 190 186 183 180 178 178 179 180 180 180 180 178 177 176 176 176 176 177 178 179
195	195	195 195 193 190 186 182 179 178 178 178 179 180 180 179 178 177 175 175 175 176 176 177 178
195	195	195 194 193 189 185 181 178 177 176 177 178 178 178 178 177 175 174 174 174 174 175 176 177
195	195	195 194 192 189 184 180 177 176 175 176 176 177 177 177 175 174 173 172 172 173 174 175 176
195	195	195 194 192 188 184 180 176 174 174 174 175 175 176 176 174 173 172 171 171 170 170 171 172
195	195	195 194 192 188 184 180 176 174 174 174 175 175 176 176 174 172 171 171 170 170 171 172 173
195	195	195 194 192 188 184 180 176 174 174 174 175 175 176 176 174 172 171 171 170 170 171 172 173
195	195	195 194 192 188 184 180 177 175 175 176 176 176 176 175 174 172 171 171 171 172 172 173 174
195	195	194 194 192 189 185 181 178 176 176 176 177 177 177 175 174 173 172 172 172 173 174 175 176
195	195	195 194 192 189 186 182 179 177 177 177 178 178 178 178 176 175 174 173 173 174 175 176 177
195	195	195 194 192 189 186 182 179 177 177 177 178 178 178 178 176 175 174 174 174 174 175 176 177
195	195	195 194 192 189 186 182 179 177 177 177 178 178 178 178 176 175 174 174 174 174 175 176 177

TABLE 4B

9 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. ft.	M = 375.0000 CM OR	22.500	WAVELENGTHS																							
PHASE ANGLE																										
-4	-22	-45	-66	-83	263	255	249	246	245	245	247	248	249	249	249	249	249	249	249	249	249	249	249			
-22	-30	-45	-63	-79	267	258	252	249	247	248	249	250	251	251	251	251	251	251	251	251	251	251	251			
-45	-45	-53	-65	-78	269	260	254	250	249	249	250	251	252	252	252	252	252	252	252	252	252	252	252			
-66	-63	-65	-73	-82	267	259	253	250	249	249	249	250	251	252	252	252	252	252	252	252	252	252	252			
-83	-79	-78	-82	-89	263	256	251	248	247	247	248	249	250	251	252	252	252	252	252	252	252	252	252			
263	267	269	267	263	257	252	248	245	244	244	245	247	248	249	250	251	251	251	251	251	251	251	251			
255	258	260	259	256	252	248	244	242	241	242	243	244	246	247	248	249	249	250	250	249	249	248	247			
249	252	254	253	251	248	244	241	239	239	240	242	244	245	246	248	248	249	249	249	249	248	247	246			
246	249	250	248	245	242	239	238	237	238	239	241	242	244	246	247	248	249	249	249	248	247	246	245			
245	247	249	249	247	244	241	239	237	237	238	240	242	244	246	247	248	249	250	249	248	247	246	245			
245	248	249	249	247	244	242	239	238	237	238	239	241	242	244	246	248	248	250	251	251	251	250	248			
247	249	250	249	248	245	243	240	239	238	239	240	242	244	246	248	250	251	253	253	252	250	249	248			
248	250	251	250	249	247	244	242	241	240	241	242	244	246	248	250	252	254	255	256	255	254	253	251			
249	251	252	251	250	248	246	244	242	242	242	244	246	248	250	252	255	257	258	259	259	258	256	254			
249	251	252	252	251	249	247	245	244	244	244	246	248	250	253	255	258	260	262	263	263	262	260	258			
249	251	252	252	251	250	248	246	246	246	248	250	252	255	258	261	263	265	267	267	266	264	263	261			
249	251	252	252	252	250	248	248	247	247	248	250	252	255	258	261	264	267	269	-88	-88	-88	269	266			
249	251	252	252	252	251	249	248	248	248	250	251	254	257	260	263	267	-89	-86	-84	-83	-84	-86	-87			
249	251	252	252	252	251	249	249	249	249	251	253	255	258	262	265	269	-86	-83	-81	-80	-80	-82	-83			
249	251	252	252	251	251	250	249	249	250	251	253	256	259	263	267	-88	-84	-81	-78	-77	-77	-78	-80			
249	251	252	252	251	251	250	249	249	251	253	255	259	263	267	-88	-83	-80	-77	-75	-75	-77	-79				
249	251	252	252	251	251	250	249	249	251	253	255	259	263	267	-88	-84	-80	-77	-75	-75	-77	-79				
249	250	251	251	251	250	249	248	248	248	250	252	254	258	262	266	-88	-84	-80	-77	-75	-75	-77				
249	250	251	251	251	250	249	248	247	247	248	250	253	256	260	264	269	-86	-82	-78	-77	-77	-82				
249	250	251	251	251	250	249	248	247	246	246	247	249	251	254	258	263	267	-87	-83	-80	-79	-82				
249	250	251	251	251	250	249	248	247	246	245	246	248	250	253	257	261	266	-89	-85	-82	-80	-83				

TABLE 4B

9 Kc, 8" Spacing
N = 26, M = 36
50 x 50 Array

axial dist. μ = 500.0000 CM OR			30.000 WAVELENGTHS																																			
PHASE ANGLE																																						
34	16	-6	-27	-45	-59	-69	-75	-78	-79	-79	-78	-76	-76	-75	-74	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73				
16	7	-7	-25	-43	-57	-67	-74	-78	-79	-79	-78	-76	-76	-75	-74	-74	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73			
-6	-7	-15	-26	-40	-53	-63	-71	-75	-77	-77	-75	-74	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73	-73			
-27	-25	-26	-31	-39	-49	-58	-65	-70	-72	-73	-73	-72	-71	-71	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70	-70			
-45	-43	-40	-39	-42	-46	-51	-56	-60	-63	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64	-64			
-59	-57	-53	-49	-46	-44	-44	-45	-45	-46	-46	-46	-47	-47	-48	-49	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50	-50			
-69	-67	-63	-58	-51	-44	-37	-32	-26	-22	-19	-16	-14	-14	-15	-17	-19	-20	-21	-21	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20	-20		
-75	-74	-71	-65	-56	-45	-32	-19	-8	0	7	13	18	21	22	22	20	18	17	16	16	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17		
-78	-78	-75	-70	-60	-45	-26	-8	5	17	25	32	38	42	45	46	45	43	42	41	41	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42		
-79	-79	-77	-72	-63	-46	-22	0	17	28	37	44	50	55	58	59	58	57	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	
-79	-79	-77	-73	-64	-46	-19	7	25	37	46	53	59	63	67	68	68	67	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
-78	-78	-77	-73	-64	-46	-16	13	32	44	53	60	66	70	74	75	76	75	74	74	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
-76	-76	-75	-72	-64	-47	-14	18	38	50	59	66	72	76	80	81	82	81	81	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
-75	-75	-74	-71	-64	-47	-14	21	42	55	63	70	76	81	84	86	87	87	86	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
-74	-74	-73	-71	-64	-48	-15	22	45	58	67	74	80	84	88	90	91	90	90	89	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
-73	-74	-73	-70	-64	-49	-17	22	46	59	68	75	81	86	90	92	93	93	92	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
-73	-73	-73	-70	-64	-50	-19	20	45	59	68	76	82	87	91	93	94	94	93	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
-73	-73	-73	-70	-64	-50	-20	18	43	58	68	75	81	87	90	93	94	93	92	92	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91	91
-73	-73	-73	-70	-64	-50	-21	17	42	57	67	74	81	86	90	92	93	92	92	91	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
-73	-73	-73	-70	-64	-50	-21	16	41	56	66	74	80	85	89	91	92	92	91	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
-73	-73	-73	-70	-64	-49	-20	16	41	56	66	73	80	85	88	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	88	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91	92	91	90	90	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89	89
-73	-73	-73	-70	-64	-49	-20	17	42	56	66	73	80	85	89	91																							

axial dist. M= 50.0000 CM OR
PRESSURE TIMES 1000.000

TABLE 5A

12 Kc, 8" Spacing
N = 26, M = 36
50 x 50 Array

0	1	2	4	5	6	7	8	9	10	11	13	14	15	15	15	15	15	15	15	15	15	15
1	3	5	7	9	11	13	15	17	19	21	24	26	28	29	29	29	29	29	29	29	29	29
2	5	8	12	15	19	22	25	28	32	35	39	43	45	47	47	47	47	47	47	47	47	47
4	7	12	17	22	28	32	37	42	48	53	58	63	67	69	70	70	70	70	70	70	70	70
5	9	15	22	30	37	44	51	59	66	73	80	87	91	94	96	96	96	96	96	96	96	96
6	11	19	28	37	47	57	67	77	87	96	105	112	118	122	123	124	124	124	124	124	124	124
7	13	22	32	44	57	70	84	97	110	122	132	141	147	151	151	154	154	154	154	154	154	154
8	15	25	37	51	67	84	101	118	134	148	160	170	177	181	184	185	185	185	185	185	185	185
9	17	28	42	59	77	97	118	139	158	174	188	199	206	211	214	215	216	216	216	216	216	216
10	19	32	48	66	87	110	131	150	170	188	213	225	234	240	243	244	244	245	245	245	245	245
11	21	35	53	73	96	122	148	174	198	219	236	249	258	265	269	270	270	270	270	270	270	270
13	24	39	58	80	105	132	160	188	213	236	254	269	279	286	290	292	293	293	293	293	293	293
14	26	43	63	87	112	141	170	199	225	249	267	284	296	304	308	310	311	311	311	311	311	311
15	28	45	67	91	118	147	177	206	234	258	279	296	309	317	321	323	324	324	324	324	324	324
15	29	47	69	94	122	151	181	211	240	265	286	304	317	325	330	332	333	333	333	333	333	333
15	29	47	70	96	123	153	184	214	243	268	290	308	321	330	335	337	337	337	337	337	337	337
15	29	48	70	96	124	154	185	215	244	270	292	310	323	332	337	339	339	339	339	339	339	339
15	29	47	70	96	124	154	185	216	244	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340
15	29	47	70	96	124	154	185	216	245	270	293	311	324	333	337	339	340	340	340	340	340	340

axial dist. M = 125.0000 CM OR 10.000 WAVELENGTHS
 PRESSURE TIMES 1000.000

TABLE 5A
 12 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

39	43	47	49	50	52	53	54	56	57	59	61	64	69	74	81	83	88	95	101	105	108	109	109	109
43	49	53	56	58	60	61	63	66	68	70	73	77	82	89	96	104	112	118	123	125	126	126	126	125
47	53	57	61	63	66	69	71	74	77	80	84	88	94	101	109	118	126	132	137	140	141	141	141	140
49	56	61	65	68	71	75	78	82	86	89	94	99	105	113	121	130	138	145	150	153	154	154	154	153
50	58	63	68	72	76	80	84	89	94	98	103	109	116	124	132	141	149	156	161	164	165	165	165	165
52	60	66	71	76	80	85	91	96	101	107	113	119	127	135	143	152	160	167	172	175	177	177	176	176
53	61	69	75	80	85	91	97	103	110	116	123	130	139	147	156	164	172	179	184	187	189	189	189	188
54	63	71	78	84	91	97	104	111	119	126	134	142	151	160	169	177	185	192	197	200	202	202	202	202
56	66	74	82	89	96	103	111	119	128	136	145	154	164	173	182	191	198	205	210	214	216	216	216	215
57	68	77	86	94	101	110	119	128	137	146	156	166	176	186	196	204	212	219	224	227	229	229	229	229
59	70	80	89	98	107	116	126	136	146	157	167	178	189	199	209	218	225	232	237	241	243	243	243	242
61	73	84	94	103	113	123	134	145	156	167	179	190	202	213	223	232	240	247	252	256	257	258	258	257
64	77	88	99	109	119	130	142	154	166	178	190	202	215	226	237	247	255	262	268	271	273	274	273	273
69	82	94	105	116	127	139	151	164	176	189	202	215	228	240	252	262	271	278	284	288	290	291	290	290
74	89	101	113	124	135	147	160	173	186	199	213	226	240	253	266	277	287	295	301	305	307	308	308	307
81	96	109	121	132	143	156	169	182	196	209	223	237	252	266	279	291	302	311	318	322	325	325	325	325
88	104	118	130	141	152	164	177	191	204	218	232	247	262	277	291	304	316	326	334	339	341	342	342	342
95	112	126	138	149	160	172	185	198	212	225	240	255	271	287	302	316	329	340	349	354	357	358	358	357
101	118	132	145	156	167	179	192	205	219	232	247	262	278	295	311	326	340	352	361	367	371	372	372	371
105	123	137	150	161	172	184	197	210	224	237	252	268	284	301	318	334	349	361	371	378	381	382	382	382
108	125	140	153	164	175	187	200	214	227	241	256	271	288	305	322	339	354	367	378	385	388	389	389	389
109	126	141	154	165	177	189	202	216	229	243	257	273	290	307	325	341	357	371	381	388	392	393	393	392
109	126	141	154	165	177	189	202	216	229	243	254	274	291	308	325	342	358	372	382	389	393	394	393	392
108	126	141	154	165	176	189	202	216	229	243	254	273	290	308	325	342	358	372	382	389	393	393	393	391
108	125	140	153	165	176	188	202	215	229	242	257	273	290	307	325	342	357	371	382	389	392	392	391	390

axial dist. M= 250.0000 CM OR 20.000 WAVELENGTHS 12 Kc, 8" Spacing
 PRESSURE TIMES 1000.000 N = 26, M = 36
 50 X 50 Array

60	66	66	65	65	66	67	69	72	73	75	75	75	75	74	75	76	78	81	83	85	87	87	87
66	66	65	65	66	67	69	72	74	75	75	75	75	75	75	75	77	79	81	83	85	86	86	86
66	65	64	64	65	67	69	71	73	75	75	74	74	74	74	75	76	78	81	83	85	86	86	86
65	65	64	64	65	66	69	71	73	74	74	74	74	74	74	76	78	81	84	85	85	85	85	85
65	65	64	64	65	66	68	70	72	73	73	73	73	73	73	74	76	79	81	84	85	85	85	85
66	66	65	65	66	67	69	70	71	72	72	72	72	72	73	74	77	80	83	85	87	87	86	86
67	67	66	66	67	67	68	70	71	72	72	72	72	72	73	75	78	82	86	89	90	90	89	89
69	69	68	68	68	68	68	69	70	71	71	72	72	72	73	76	80	85	89	93	94	94	93	92
72	72	71	71	70	70	70	70	71	71	72	72	72	72	74	77	82	88	93	97	99	99	98	95
73	74	73	73	72	71	71	71	71	72	72	72	71	72	74	78	84	90	96	100	102	102	101	100
75	75	75	74	73	72	72	71	72	72	72	71	71	72	74	78	85	91	98	102	104	105	103	102
75	75	75	74	73	73	72	72	72	72	71	71	71	71	74	79	85	92	99	103	106	106	105	103
75	75	75	74	73	72	72	71	71	71	71	71	70	71	74	79	86	93	100	105	107	107	106	104
75	75	74	74	73	72	72	72	72	72	72	72	71	72	75	81	87	95	102	106	108	108	107	105
75	75	74	74	73	72	72	72	72	72	72	72	71	71	72	75	81	87	95	102	106	108	108	107
74	75	74	74	73	73	73	73	73	74	74	74	74	74	75	79	84	91	98	105	109	111	111	108
75	75	75	74	74	74	74	74	74	74	74	74	74	74	75	79	84	89	96	103	109	114	114	112
76	77	76	76	76	77	78	80	82	84	85	85	85	85	86	87	91	96	102	109	116	120	122	120
78	79	78	78	79	80	82	85	88	90	91	92	93	95	98	103	109	116	122	127	129	129	128	126
81	81	81	81	81	83	86	89	93	96	98	99	100	102	105	109	116	122	129	133	136	137	136	134
83	83	83	84	85	89	93	97	100	102	103	105	106	109	114	120	127	133	139	142	143	143	142	141
85	85	85	84	85	87	90	94	99	102	104	106	107	108	111	116	122	129	136	142	146	148	148	147
86	86	85	85	85	87	90	94	99	102	105	106	107	108	111	116	122	129	137	143	148	150	151	151
87	86	86	85	85	87	90	93	98	101	103	105	106	107	110	114	120	126	136	143	148	151	152	152
87	86	86	85	85	87	90	92	96	100	102	103	104	105	108	112	118	126	134	142	148	151	152	153
87	86	86	85	85	87	90	92	95	99	101	102	103	104	107	111	117	125	133	141	147	151	152	153

axial dist. $\mu = 375.0000$ CM OR PRESSURE TIMES 1000.000

30.000

WAVELENGTHS

TABLE 5A

12 Kc, 8" Spacing
 $N = 26, M = 36$
 50 x 50 Array

67	67	65	62	59	56	54	54	53	51	51	48	43	38	33	28	24	22	23	27	31	35	39	42	44	45	
67	66	64	61	58	55	54	53	52	51	48	43	38	33	28	24	22	23	27	31	35	39	42	44	46		
65	64	62	59	56	54	53	52	52	50	47	43	38	33	28	24	22	24	27	32	36	40	43	46	47		
62	61	59	57	54	52	52	52	52	50	47	43	38	33	28	24	23	25	28	33	37	42	45	48	49		
59	58	56	54	52	51	51	52	52	51	48	44	39	34	29	26	25	26	30	35	40	45	48	51	53		
56	55	54	52	51	51	52	53	54	53	50	46	40	35	31	28	27	29	32	33	43	43	43	53	58		
54	54	53	52	51	52	53	55	56	55	52	48	43	38	33	30	30	31	36	41	47	53	58	62	64		
54	53	52	52	52	53	55	57	57	57	54	50	45	40	36	33	33	35	39	45	51	58	64	68	70		
53	52	52	52	52	54	56	57	58	58	55	51	47	42	38	36	35	37	42	48	55	63	69	74	76		
51	51	50	50	51	53	55	57	58	57	55	52	47	43	39	37	37	37	40	44	51	59	66	73	79	82	
48	48	47	47	48	50	52	54	55	55	53	50	46	43	40	38	38	38	41	46	53	61	69	77	82	85	
43	43	43	43	44	46	48	50	51	52	50	48	44	41	39	38	38	41	47	54	62	71	79	85	88		
38	38	38	38	39	40	43	45	47	47	46	44	42	39	38	37	38	41	47	54	63	72	80	86	89		
33	33	33	33	34	35	38	40	42	43	43	41	39	37	36	36	38	41	47	54	63	72	80	86	89		
28	28	28	28	29	31	33	36	38	39	40	39	38	36	36	36	38	42	47	54	63	72	80	86	89		
24	24	24	24	26	28	30	33	36	37	38	38	37	36	36	37	39	42	48	55	63	72	80	86	89		
22	22	22	23	25	27	30	33	35	37	38	38	38	38	38	39	41	44	49	56	64	72	80	86	90		
23	23	24	25	26	29	31	35	37	40	41	41	41	41	41	42	44	47	52	58	65	74	81	87	90		
27	27	27	28	30	32	36	39	42	44	46	47	47	47	47	48	49	52	56	61	68	76	83	89	92		
31	31	32	33	35	38	41	45	48	51	53	54	54	54	54	55	56	58	61	66	73	80	87	92	95		
35	35	36	37	40	43	47	51	55	59	61	62	63	63	63	64	64	65	68	73	79	85	91	96	99		
39	39	40	42	45	48	53	58	63	66	69	71	72	72	72	72	72	74	76	80	85	91	97	101	104		
42	42	43	45	48	53	58	64	69	73	77	79	80	80	80	80	80	80	81	83	87	91	97	102	106	108	
44	44	46	48	51	56	62	68	74	79	82	85	86	86	86	86	86	86	87	89	92	96	101	106	110	112	
45	46	47	49	53	58	64	70	76	82	85	88	89	89	89	89	89	90	90	90	92	95	99	104	108	112	114

TABLE 5A
 12 Kc, 8" Spacing
 N = 26, M = 36
 50 X 50 Array

AXIAL DIST. M = 500.0000 CM OR 40.000 WAVLENGTHS
 PRESSURE TIMES 10000.000

756	738	704	648	571	473	360	240	123	28	89	169	238	297	346	384	410	422	424	419	411	405	401	401	401
738	723	690	638	563	467	356	237	121	35	96	175	244	304	353	391	417	430	432	426	418	411	407	406	406
704	690	661	612	541	449	340	224	111	45	112	191	260	319	369	407	433	446	448	442	433	424	419	417	416
648	638	612	568	501	414	309	197	92	66	142	220	289	348	397	436	462	475	468	456	445	438	434	432	
571	563	541	501	440	357	258	152	69	104	187	265	333	392	441	480	505	516	515	505	490	475	464	454	455
473	467	449	414	357	280	187	96	82	163	250	327	394	451	499	537	561	570	566	552	532	513	498	488	484
360	356	340	309	258	187	107	75	148	242	328	404	468	524	570	606	628	636	628	610	585	560	540	526	519
240	237	224	197	152	96	75	143	238	332	417	489	551	604	647	681	702	707	697	674	644	613	586	564	558
123	121	111	92	69	82	148	238	334	426	507	576	634	682	723	754	773	777	764	737	702	665	633	613	598
28	35	45	66	104	163	242	332	426	514	591	655	709	753	790	819	836	837	823	793	754	713	676	644	634
89	96	112	142	187	250	328	417	507	591	663	722	770	810	842	867	882	883	867	836	794	749	708	677	661
169	175	191	220	265	327	404	489	576	655	722	776	818	851	879	900	913	912	895	863	820	773	730	697	679
238	244	260	289	333	394	468	551	634	709	770	816	853	881	903	920	930	927	909	877	833	786	742	708	690
297	304	319	348	392	451	524	604	682	753	810	851	881	903	919	932	937	933	914	882	839	792	747	713	695
346	353	369	397	441	499	570	647	723	790	842	879	903	919	930	934	941	934	915	884	843	798	754	720	702
384	391	407	436	480	537	606	681	754	819	867	900	920	932	938	942	942	934	915	884	843	798	754	720	702
410	417	433	462	505	561	628	702	773	836	882	913	930	937	941	942	940	931	913	884	845	800	757	723	704
422	430	446	475	516	570	636	707	777	837	883	912	927	933	934	934	931	923	907	880	842	798	755	721	703
424	432	448	475	515	566	628	697	764	823	867	895	909	914	915	915	913	907	892	867	831	789	746	711	692
419	426	442	468	505	552	610	674	737	793	836	863	877	882	884	884	884	880	867	844	809	767	724	689	669
411	418	433	456	490	532	585	644	702	754	794	820	833	839	842	841	845	842	831	809	775	733	690	654	634
405	411	424	445	475	513	560	613	665	713	749	773	786	792	795	798	800	798	789	767	733	690	647	611	591
401	407	419	438	464	498	540	586	633	676	708	730	742	747	751	754	757	755	746	724	690	647	602	566	546
401	406	417	434	458	488	526	568	610	648	677	697	708	713	717	720	723	721	711	689	654	611	566	531	511
401	406	416	432	455	484	519	558	598	634	661	679	690	695	698	702	704	703	692	669	634	591	546	511	491

axial dist. h = 750.0000 CM OR
PRESSURE TIMES 10000.CC0 60.000 WAVELENGTHS

TABLE 5A
12 Kc, 8" Spacing
N = 26, M = 36
50 x 50 Array

32	14	13	48	89	134	180	227	274	317	353	374	391	397	397	396	395	394	395	395	395	395	395	395	395
14	3	28	61	99	140	185	231	277	320	355	379	392	396	394	392	392	392	392	392	392	392	393	393	393
13	28	52	82	118	157	200	246	292	335	369	391	402	404	402	398	395	394	393	394	394	394	394	395	394
48	61	82	111	146	185	229	276	323	365	398	418	426	425	420	413	408	405	403	403	404	404	404	405	404
89	99	118	146	182	224	271	322	371	413	444	461	466	462	453	442	434	428	425	422	423	424	424	425	425
134	140	157	185	224	271	324	379	431	474	503	517	518	510	497	482	470	461	455	452	452	452	453	453	454
180	185	200	229	271	324	383	443	497	540	567	577	574	561	544	526	510	497	484	483	482	482	483	484	484
227	231	246	276	322	379	443	506	561	602	626	636	625	609	586	564	544	527	516	509	506	507	508	509	509
274	277	292	323	371	431	497	561	615	653	672	674	661	640	615	590	566	546	531	522	519	519	520	521	522
317	320	335	365	413	474	540	602	653	687	700	697	680	655	627	599	572	549	532	521	517	517	518	519	520
353	355	369	398	444	503	567	626	672	700	709	701	681	653	623	593	564	539	520	508	503	502	504	505	506
378	379	391	418	461	517	577	632	674	697	701	685	666	638	607	576	547	521	500	487	481	480	481	483	484
391	392	402	426	466	518	574	625	661	680	681	666	643	614	584	554	525	499	478	464	458	456	457	458	459
397	396	404	425	462	510	561	604	640	655	653	638	614	587	558	530	503	478	457	443	435	433	434	435	436
397	396	402	420	453	497	544	586	615	627	623	607	584	558	532	507	481	458	437	423	415	412	413	414	415
396	394	398	413	442	482	526	564	590	599	593	576	554	530	507	483	460	438	418	404	396	394	394	394	395
395	392	395	408	434	470	510	544	566	572	564	547	525	503	481	460	439	418	400	385	377	373	373	374	375
394	392	394	405	428	461	497	527	546	549	539	521	499	474	458	434	418	399	386	366	357	354	353	354	355
395	392	393	403	425	455	488	516	531	532	520	500	478	457	437	414	400	380	363	348	334	325	322	322	322
395	392	393	403	423	452	483	509	522	521	508	487	464	441	421	404	385	366	348	334	325	322	321	322	322
395	393	394	403	423	452	482	506	519	517	503	481	458	435	415	396	377	357	340	325	317	313	312	313	314
395	393	394	404	424	452	482	507	519	517	502	480	456	433	412	393	373	354	336	322	313	309	309	309	310
395	393	394	404	424	453	483	508	520	518	504	481	457	434	413	393	373	353	335	321	312	308	308	309	310
395	393	395	405	425	453	484	509	521	519	505	483	456	435	414	394	374	354	336	322	313	309	309	310	311
395	393	394	404	425	454	484	509	522	520	506	484	459	436	415	395	375	355	337	322	314	310	310	311	311

axial dist. H = 125.0000 CW OR

10.000 WAVELENGTHS

TABLE 5B

12 Kc, 8" Spacing
N = 26, M = 36
50 x 50 Array

-27	-28	-28	-26	-25	-23	-22	-20	-19	-18	-18	-19	-20	-22	-24	-25	-26	-26	-25	-24	-23	-22	-22	-21	-21
-28	-29	-29	-28	-26	-24	-22	-21	-19	-18	-17	-16	-17	-14	-20	-22	-24	-24	-24	-23	-22	-22	-21	-21	-21
-28	-29	-28	-27	-25	-23	-20	-18	-16	-15	-14	-13	-14	-15	-17	-19	-20	-21	-22	-21	-21	-20	-19	-19	-19
-28	-28	-27	-25	-23	-20	-18	-15	-13	-11	-10	-10	-10	-11	-13	-15	-17	-18	-18	-18	-17	-17	-16	-16	-16
-26	-26	-25	-23	-20	-17	-14	-12	-9	-8	-6	-6	-6	-6	-7	-9	-11	-13	-14	-15	-15	-14	-13	-13	-13
-25	-24	-23	-20	-17	-14	-11	-8	-5	-3	-2	-2	-2	-2	-3	-5	-7	-9	-10	-11	-11	-10	-9	-9	-9
-23	-22	-20	-18	-14	-11	-7	-4	-2	-0	1	1	1	0	-1	-3	-5	-6	-7	-7	-7	-6	-6	-6	-6
-22	-21	-18	-15	-12	-8	-4	-1	1	3	4	5	4	3	2	0	-1	-3	-4	-3	-3	-3	-3	-3	-2
-20	-19	-16	-13	-9	-5	-2	1	4	6	7	4	7	6	4	2	1	-0	-1	-1	-1	-0	-0	-0	-0
-19	-18	-15	-11	-8	-3	-0	3	6	8	9	10	9	8	6	5	3	2	1	0	1	1	1	1	1
-18	-17	-14	-10	-6	-2	1	4	7	9	10	11	10	9	8	6	4	3	2	2	2	2	2	2	2
-18	-16	-13	-10	-6	-2	1	5	8	10	11	11	11	10	8	7	5	4	3	2	3	3	3	3	3
-19	-17	-14	-10	-6	-2	1	4	7	9	10	11	10	9	8	6	5	3	2	2	2	2	2	2	2
-20	-18	-15	-11	-7	-3	0	3	6	8	9	10	9	8	7	5	3	2	1	1	1	1	1	1	1
-22	-20	-17	-13	-9	-5	-1	2	4	6	8	8	7	5	3	2	0	0	0	0	0	0	0	0	0
-24	-22	-19	-15	-11	-7	-3	0	2	5	6	7	6	5	3	2	0	-1	-2	-2	-1	-1	-1	-1	-1
-25	-23	-20	-17	-13	-9	-5	-1	1	3	4	5	5	3	2	0	-1	-2	-3	-4	-3	-3	-3	-3	-3
-26	-24	-21	-18	-14	-10	-6	-3	-0	2	3	4	3	2	0	-0	-2	-4	-5	-5	-5	-4	-4	-4	-4
-26	-24	-22	-18	-15	-11	-7	-3	-1	1	2	3	2	1	0	-1	-3	-5	-6	-6	-6	-5	-5	-5	-5
-25	-24	-21	-18	-15	-11	-7	-4	-1	0	2	2	2	1	-0	-2	-4	-6	-6	-6	-6	-5	-5	-5	-5
-24	-23	-21	-18	-14	-10	-7	-3	-1	1	2	3	2	1	-0	-2	-3	-5	-6	-6	-5	-5	-5	-5	-5
-23	-22	-20	-17	-13	-10	-6	-3	-0	1	2	3	2	1	0	-1	-3	-5	-6	-6	-5	-5	-5	-5	-5
-23	-22	-19	-17	-13	-9	-6	-3	-0	1	2	3	2	0	-1	-3	-4	-5	-5	-5	-4	-4	-4	-4	-4
-22	-21	-19	-16	-13	-9	-6	-3	-0	1	3	3	2	0	-1	-3	-4	-5	-5	-5	-4	-4	-4	-4	-4
-22	-21	-19	-16	-13	-9	-6	-2	-0	1	3	3	2	0	-1	-3	-4	-5	-5	-4	-4	-4	-4	-4	-4

axial dist. r = 250.0000 CM OR 20.000 WAVELENGTHS
 PHASE ANGLE

TABIE 5B

12 Kc, 8" Spacing
 N = 26, M = 36
 50 X 50 Array

217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	

TABLE 5B

axial dist. = 375.0000 CM OR 30.000 WAVELENGTHS

12 Kc, 8" Spacing
N = 26, M = 36
50 x 50 Array

PHASE ANGLE

100	100	99	101	103	106	114	119	123	125	125	126	128	134	145	162	180	195	204	215	223	229	234	237		
100	99	100	103	108	114	119	123	125	126	126	128	134	146	162	180	195	207	216	223	229	234	237			
99	99	100	104	109	115	120	124	126	126	127	129	135	147	163	181	196	207	216	224	230	234	237			
101	100	100	102	106	111	117	122	126	127	128	128	131	137	149	165	182	197	208	216	224	230	234	237		
103	103	104	106	109	115	120	125	128	130	130	130	133	140	151	167	183	197	208	216	223	229	233	235		
108	108	109	111	115	119	124	128	131	132	132	133	136	143	154	169	184	197	207	216	222	227	231	233		
114	114	115	117	120	124	129	132	133	134	134	134	136	139	146	156	170	184	197	207	214	220	225	228	230	
119	119	120	122	125	128	132	134	135	136	136	136	138	141	148	158	171	184	196	206	213	219	223	226	227	
123	123	124	126	128	131	133	133	135	136	137	137	137	139	143	150	160	172	184	196	205	212	217	221	224	225
125	125	126	127	130	134	134	136	137	137	137	137	138	140	145	151	161	173	185	196	205	212	217	221	223	224
125	126	126	128	130	132	134	136	137	137	138	139	141	146	153	162	174	186	196	205	212	217	220	223	224	
125	126	126	128	130	132	134	136	137	137	138	139	141	146	153	162	174	186	196	205	212	217	220	223	224	
126	126	126	128	130	132	134	136	137	137	138	139	141	146	153	162	174	186	196	205	212	217	220	223	224	
126	126	127	128	130	133	136	139	140	141	143	146	151	158	167	177	188	198	206	213	218	221	223	224		
128	128	129	131	133	136	139	141	143	145	146	148	151	156	162	171	180	190	199	207	213	218	221	223	224	
134	134	135	137	140	143	146	148	150	151	153	155	158	162	168	175	184	193	201	209	214	218	221	223	224	
145	146	147	149	151	154	156	158	160	161	162	164	167	171	175	181	188	196	203	210	215	219	222	224	225	
162	162	163	165	167	169	170	171	172	173	174	175	177	180	184	188	194	200	206	212	216	220	223	224	225	
180	180	181	182	183	184	184	184	185	186	187	188	190	193	196	200	205	210	214	218	222	224	225	226	227	
195	195	196	197	197	197	197	196	196	196	197	198	199	201	203	206	210	214	217	221	223	225	226	227	228	
206	207	207	208	208	207	207	206	205	205	205	206	207	208	210	212	214	217	220	223	225	226	227	228	229	
215	216	216	216	216	214	213	212	212	212	212	213	213	214	215	216	218	221	223	225	226	227	228	229	230	
223	223	224	224	223	222	220	219	217	217	217	218	218	218	219	220	222	223	225	226	227	228	229	230	231	
229	229	230	230	229	227	225	223	221	221	220	220	221	221	221	222	223	224	225	226	227	228	229	230	231	
234	234	234	234	233	231	228	226	224	223	223	223	223	223	224	224	225	226	227	228	229	230	231	232	233	
237	237	237	237	235	233	230	227	225	224	224	224	224	224	225	225	226	227	228	229	230	231	232	233	234	

TABLE 5B
 12 Kc, 8" Spacing
 N = 26, M = 36
 50 x 50 Array

axial dist. = 500.0000 CM CR 40.000 WAVELENGTHS

PHASE ANGLE

-21	-24	-26	-29	-32	-35	-38	-41	-47	156	163	156	154	155	157	160	163	167	169	171	172	172	171	171	171	
-24	-26	-29	-31	-34	-37	-40	-44	-52	244	166	157	155	156	158	161	164	167	169	171	172	172	171	171	171	171
-26	-29	-31	-34	-37	-40	-43	-48	-60	224	167	158	156	156	158	161	164	167	169	171	171	171	171	170	170	170
-29	-31	-34	-37	-40	-43	-48	-55	-76	199	165	158	156	156	158	160	163	166	168	169	170	170	169	169	169	169
-32	-34	-37	-40	-44	-48	-53	-65	-84	250	178	160	155	154	154	156	158	161	163	165	166	167	167	166	166	166
-35	-37	-40	-43	-48	-53	-62	-84	195	163	154	151	151	151	153	154	157	160	161	162	162	162	162	163	163	163
-38	-40	-43	-48	-53	-62	-84	207	164	152	148	147	147	148	149	152	154	155	157	157	157	157	157	158	159	159
-41	-44	-48	-55	-65	-88	207	164	151	146	144	144	144	145	147	148	150	152	153	153	153	153	153	153	154	155
-47	-52	-60	-76	250	195	164	151	145	143	142	142	142	143	145	146	148	149	150	150	150	150	150	151	151	151
256	244	224	199	178	163	152	146	143	141	140	141	141	143	144	145	147	148	148	148	148	148	148	149	149	149
163	166	167	165	160	154	148	144	142	140	140	141	142	143	144	145	146	147	147	147	147	147	147	147	148	148
155	157	158	158	155	151	147	144	142	141	141	142	143	145	146	147	147	147	147	147	147	147	147	147	147	148
154	155	156	156	154	151	147	144	142	141	142	143	144	146	147	148	148	148	148	148	148	148	148	148	148	148
155	156	156	156	154	151	148	145	143	143	143	143	144	146	147	148	148	148	148	148	148	148	148	148	148	148
157	150	158	158	156	153	149	147	145	144	144	145	146	147	148	149	149	149	149	149	149	149	149	149	149	149
160	161	161	160	158	155	152	148	146	145	146	147	148	149	149	150	149	149	149	149	149	149	149	149	149	149
163	164	164	163	161	157	154	150	148	147	147	148	148	149	150	149	149	149	149	149	149	149	149	149	149	149
167	167	167	166	163	160	155	152	149	148	147	147	148	149	149	149	149	149	149	149	149	149	149	149	149	149
169	169	169	168	165	161	157	153	150	148	147	147	148	148	149	149	149	149	149	149	149	149	149	149	149	149
171	171	171	169	166	162	157	153	150	148	147	147	147	148	148	148	148	148	148	148	148	148	148	148	148	148
172	172	171	170	167	162	157	153	150	148	147	146	147	147	147	147	147	147	147	147	147	147	147	147	147	147
172	172	171	170	167	162	157	153	150	147	147	146	146	147	147	147	147	146	145	144	143	142	141	142	142	143
171	171	171	169	166	162	158	153	150	148	147	147	147	147	147	147	147	147	146	144	143	142	142	142	143	144
171	171	170	169	166	163	158	154	151	149	148	147	148	148	148	148	147	146	145	144	143	142	143	143	144	144
171	171	170	169	166	163	158	154	151	149	148	147	148	148	148	148	147	146	145	144	143	142	143	143	144	144

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