Reproduced by

AIR DOCUMENTS DIVISION

TECHNICAL INTELLIGENCE

T-2

AMC

HEADQUARTERS AIR MATERIEL COMMAND

WRIGHT FIELD, DAYTON, OHIO

The U.S. GOVERNMENT

IS ABSOLVED

FROM ANY LITIGATION WHICH MAY

ENSUE FROM THE CONTRACTORS IN-

FRINGING ON THE FOREIGN PATENT

RIGHTS WHICH MAY BE INVOLVED.

REEL – C
263
A.T.I.
8120

~~CONFIDENTIAL~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: MAR 2 7 2012

CONFIDENTIAL

REFERENCE No. VI-4

DATE April 29, 1946

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS
WASHINGTON 25, D. C.

E/NBS-R-VI-4

National Bureau of Standards Report

PRELIMINARY REPORT ON DIFFUSER-SCREEN COMBINATIONS FOR REDUCING WIND-TUNNEL TURBULENCE

by

G. B. Schubauer and W. G. Spangenberg

A Progress Report
on

Investigation of the Effect of Fine Screens in Wide-Angle Diffusers (NACA Research Authorization No. 846-3)

Form 404

U. S. GOVERNMENT PRINTING OFFICE

Preliminary Report on Diffuser-Screen Combinations for Reducing Wind-Tunnel Turbulence

Introduction

An investigation of the effect of fine screens in wide-angle diffusers was undertaken after it was reported by McLellan and Nichols (reference 1) that the efficiency of a diffuser was improved by a screen across the downstream end. Velocity measurements showed that the resistance imposed by the screen assisted in the filling of the diffuser. The effect was later confirmed by Squire and Hogg (reference 2). None of the investigators, however, studied the effect in sufficient detail to explain how the filling was accomplished nor what arrangements would give the best results. The purpose of the present investigation was first to gain an understanding of the process, and second to discover the practical possibilities of diffuser-screen combinations.

The greater part of the experimental work done so far has been to study the flow phenomena with single screens spanning various sections of a conical diffuser. By making detailed surveys of the dynamic and static pressures throughout the diffuser, particularly in the neighborhood of a screen, the action of the screen and the process by which it distributes the flow have been made clear. A brief discussion of this aspect of the problem will be given here. Details of the experimental results will be given later in a comprehensive final report.

The present report deals mainly with one of the possible applications of diffuser-screen combinations; namely, the use of a wide-angle diffuser to prevent pressure drop through damping screens located ahead of the entrance cone of a wind tunnel to reduce turbulence. A schematic arrangement is shown in Figure 1. The effectiveness of fine screens in reducing turbulence is shown in reference 3, and screens are now used in a number of wind tunnels where low turbulence is desired. A rapid expansion in cross section ahead of screens has also been employed to advantage to reduce the pressure drop through screens, and the idea of distributing screens through a wide-angle diffuser, as shown in Figure 1, was suggested several years ago. Arrangements of this sort have now been investigated and some interesting possibilities have appeared that may be useful to those who may wish to use damping screens.

If diffuser-screen combinations are to be used to reduce turbulence, the first requirement is that there shall be no flow separation in the diffuser. If separation occurs, the diffuser will probably generate more turbulence than the screens can damp out, and the instability accompanying separation will probably give rise to objectionable pulsations. The first question to consider is then whether screens can prevent flow separation in a diffuser of such wide angle that separation would normally be expected. Since so much depends on this question, a brief discussion will be given of the experiments performed to find out how a screen affects the flow in a diffuser.

Symbols

q = dynamic pressure.

p = static pressure.

A = cross-sectional area of duct or diffuser.

PE = flow of potential energy.

KE = flow of kinetic energy.

Subscripts o, 1, 2, ... n when used with q, p, PE, KE, and A refer to specific positions, see Fig. 1. For example, q_o and p_o are the dynamic and static pressures in the duct at the entrance to the diffuser.

q_r = reference pressure. Actually this is the pressure drop across the entrance cone C, Fig. 2.

Δp = change in static pressure across a screen or between two points, the points being denoted by subscripts.

k = pressure-drop coefficient of screen.

n = number of screens.

r = ratio of turbulent fluctuations downstream from a number of screens to the fluctuations upstream from the screens.

Experiments on Single Screens

The experimental arrangement for studying diffuser-screen combinations is shown in Figure 2. A centrifugal fan at the far end draws the air through the system which consists of a conical diffuser, D, between two lengths of round duct forming the entrance and exit. The diffuser, shown again in Figures 3 and 4, is the only one on which results have been obtained so far. Its shape and dimensions are shown in Figure 5. The area ratio is 4 to 1 and the total included angle is about 28 degrees.

The 18-inch diameter entrance duct with the screened entrance cone (C in Figure 2) is made up of four 3-foot sections so that the entrance length may be varied. The full 12-foot length is the only arrangement used so far in any of the tests. The 36-inch diameter exit duct is also made up in sections, but the full length of 18 feet was always used. The inlet of the fan connects directly to the 36-inch duct. Speed control is obtained by radial inlet vanes on the fan.

Fine screens were obtained in a variety of solidities so that screens with pressure-drop coefficients from 0.5 to 2.6 were available for study. The pressure-drop coefficient, denoted by k, is defined as

$$k = \frac{\Delta p}{q}$$

where Δp is the pressure drop across the screen and q is the dynamic pressure of the flow through the screen, k was determined in all cases by measuring Δp and q for a sample of each screen installed in the 18-inch duct 3 feet from the end of the entrance cone. In all cases k was found to depend on the wind speed (or more accurately stated, on the Reynolds Number) as well as on the solidity.

The screens were installed one at a time in various cross sections of the diffuser, and for each screen in each position surveys of the dynamic pressure and static pressure were made throughout the diffuser. A specially constructed pitot-static tube of small dimensions was used so that pressures could be measured to within one inch of the upstream side of a screen and to within 1/2 inch of the downstream side. All runs were made with an entrance duct length of 8 diameters (12 feet) and an entrance velocity of about 100 feet per second. By following this somewhat tedious procedure much was learned about the so-called "filling" process and phenomena appeared that were not at all in accord with previously conceived notions on the subject. For example, it was assumed that, with a screen placed in some section of a diffuser where the flow would normally be separated, the pressure drop across the screen would force the dead air through and thus would induce a flow in regions where none existed before. The effect was assumed to be analogous to removal of wake or boundary layer by suction. This concept was based on the supposition that the static pressure would be essentially constant over any cross section. When measurements were made with a screen placed across the extreme downstream end of the diffuser (which was the first arrangement to be tried), it was found that the static pressure was far from constant over a cross section, but was higher in the center than at the edges just ahead of the screen and was just the reverse immediately behind the screen. The difference in static pressure across the screen at any point was just equal to k times the local dynamic pressure. Accordingly, where the velocity was zero, as in the dead air regions, there was no pressure drop and consequently no suction effect. Since separation occurred well forward in the diffuser (about 5 inches from the entrance end), this case corresponded approximately to that of a jet impinging against the screen. The only effect of the screen that in any way approached a filling effect was a divergence of this jet as it approached the screen and a continuation of the divergence on the downstream side.

After several screens with a variety of coefficients were investigated in the downstream end of the diffuser, the same routine was repeated at 6-inch intervals taken progressively farther and farther upstream, with only one screen in the diffuser at a time. In all cases the effect was essentially the same; namely, a divergence of the stream on the approach side in the manner of a free jet and a continued divergence of the stream on the downstream side. The dead-air spaces were reduced by the spreading of the jet but otherwise appeared to be unaffected. Since lateral spreading was rapid near the screen at the edges of the jet, the stream continued to spread rapidly on the downstream side and in nearly all cases reached the walls of the diffuser just aft of the screen and strongly resisted separation from then on. Thus the dead air space was eliminated on the downstream side of the screen even though one existed on the upstream side. The screen therefore exhibited a far greater filling effect on the downstream side than on the upstream side. This sets certain definite requirements on the positioning of a screen if separation ahead is to be prevented. In a straight-sided conical diffuser the screen may be only a little aft of the separation point (a few inches in the present diffuser), otherwise there will always exist a "bubble" of trapped dead air regardless of the pressure-drop coefficient of the screen.

So far the term "filled" has been used rather loosely to mean flow without separation. Actually there may be all degrees of filling from a nearly stagnant region near the walls with an S-shaped velocity distribution characteristic of incipient separation to a condition approaching a thin boundary layer with a high velocity gradient near the walls. In order to give the word definite meaning, a filled condition will be defined as the condition where the velocity distribution is similar to the distribution just ahead of the diffuser. According to this definition, a diffuser is filled throughout when the distribution of axial velocity across any plane normal to the axis is similar to the distribution of velocity across a section of the parallel duct just ahead of the diffuser. It was found that no single screen studied would fill the diffuser in accordance with this definition. When a screen was placed just far enough forward to prevent separation on the upstream side and had a k value high enough to keep separation from taking place in the remainder of the diffuser, the diffuser was somewhat underfilled ahead of the screen and overfilled just aft of the screen. The term "underfilled" refers to an altered distribution with velocities proportionately lower near the wall and higher near the center, and "overfilled" refers to the reverse condition where the velocities are proportionately higher near the walls and lower in the center. These are purely qualitative terms. It appeared, however, that by proper choice of k and proper placing of several screens a fair approach to a filled condition could be realized.

In all cases efficiencies were calculated from the observed static and dynamic pressure. The efficiency of a diffuser is usually defined as the ratio of the increase in the flow of pressure energy to the loss in the flow of kinetic energy on passing through the diffuser. This definition was adopted in the present work. Local efficiencies were defined in terms of this ratio taken between any two cross sections. Where the static and dynamic pressures varied over a cross section, the flow of kinetic and pressure energy had to be obtained by summation. Local efficiencies were found to be high in regions where separation was prevented by a screen, provided no screen was between the two cross sections considered. As the filled condition was approached between any two cross sections, the local efficiency there approached 100 percent. The efficiency always took a sharp drop through a screen because of the drop in static pressure across the screen. From this it may be concluded that the significant losses in a filled diffuser will occur at the screens.

A Criterion for the Selection of Diffuser-Screen Combinations

When screens are selected solely for the reduction of turbulence, the aim is to use as many screens as possible or as high a k value as possible consistent with the allowable reduction in energy ratio of the tunnel. When selecting a diffuser-screen combination for the reduction of turbulence there is in addition the very important requirement that there shall be no flow separation in the diffuser. From the results with single screens it was evident that a filled or overfilled condition could be obtained, at least in the portion of the diffuser aft of the first screen, merely by using enough screens. The overall efficiency was sure to be low with any of the screens on hand, but in principle at least it could be varied at will by having an unlimited selection of k values.

For example, a filled condition obtained with many screens of low k value would produce higher efficiencies than few screens of high k value. It seemed most logical therefore to decide on the efficiency desired and then aim for the greatest possible turbulence reduction under these conditions.

In most modern wind tunnels the ratio of q_o to q_w (Fig. 1) is so small that q_o is a negligible factor in the power consumption. If then the flow of kinetic energy in section o is all that is lost, the price in power consumed will probably not be too much to pay for the privilege of using screens. It seems reasonable therefore to require only that there shall be no drop in static pressure across a diffuser-screen combination. This means that a diffuser of any size may be used, i.e., A_n/A_o may be as large as desired, and that the overall efficiency is to be zero. It was decided to adopt this criterion and then try to produce the optimum arrangement of screens in the 28-degree diffuser.

<u>Relations for the Selection and Placing of Screens for No Pressure Drop</u>

On the basis of experience with single screens in the 28-degree diffuser, it appeared that a few simple relations might serve to govern the selection and placing of screens in a diffuser to attain the condition of no pressure drop. The relations will be valid only if the diffuser is filled. While results with other diffusers would be very helpful, it appears from the results now available that filling is always possible if screens with a sufficiently low k value can be obtained. The unknown factor in the procedure is the permissible upper limiting value of the k or solidity for the screens, since this depends on the angle and shape of the diffuser and the condition of the entering flow.

When the velocity distributions in all sections of the diffuser are similar (filled condition), the axial velocity in different sections is inversely proportional to the cross-sectional area. If the energy losses in regions not occupied by screens are negligible, the total pressure along each streamline is constant until a screen is met, and the static pressure rise from section o to section 1 (Figure 1) is given by

$$\Delta p_{01} = q_0 - q_1 \tag{1}$$

Also, by neglecting any difference between the total velocity and the axial component

$$q_1/q_0 = (A_0/A_1)^2 \tag{2}$$

From (1) and (2)

$$\Delta p_{01} = q_0 \left[1 - \left(\frac{A_0}{A_1}\right)^2\right] \tag{3}$$

Screen 1 is now to be placed so that the pressure drop through it is just equal to Δp_{01}. If k_1 is the pressure-drop coefficient of screen 1, the pressure drop is given by $k_1 q_1$, and when the screen is in the desired position

$$k_1 q_1 = q_0 \left[1 - \left(\frac{A_0}{A_1} \right)^2 \right] \qquad (4)$$

By means of equation (2), equation (4) reduces to

$$A_1/A_0 = (k_1 + 1)^{1/2} \qquad (5)$$

If successive screens are positioned by the same rule, it follows that

$$\frac{A_2}{A_1} = (k_2+1)^{1/2}, \quad \frac{A_3}{A_2} = (k_3+1)^{1/2}, \ \ldots \ \frac{A_n}{A_{n-1}} = (k_n+1)^{1/2} \qquad (6)$$

Thus the cross-sectional area and consequently the axial position of each screen is determined in terms of the k value for the screen.

The overall area ratio is

$$A_n/A_0 = (k_1+1)^{1/2}(k_2+1)^{1/2} \ldots (k_n+1)^{1/2} \qquad (7)$$

or

$$A_n/A_0 = (k+1)^{\frac{n}{2}} \qquad (8)$$

if all of the k's are the same. This will be approximately the case when all screens are alike. When the area ratio of the diffuser is specified, the number of screens is fixed by k. For example, in the present diffuser with $A_n/A_0 = 4$, the the following numbers are found by equation (8):

k	Number of screens (n)
0.5	7
1	4
3	2
15	1

Without additional information, it would not be known whether to use 1 screen with a k value of 15, or 7 screens with a k value of 0.5. For the 28-degree diffuser with the relatively thick boundary layer produced by an entrance duct length of 8 diameters, enough information was already available from experiments on single screens to limit the choice to k values of 1.4 or less. Accordingly, the arrangements shown in Figures 5 and 6 resulted by applying the foregoing relations. The performance of these two arrangements is taken up in the following section.

A designer lacking aerodynamic data on his diffuser could do little more than choose fine screens with the lowest solidity obtainable and hope that the k values were sufficiently low. Since this situation is rather unsatisfactory, an effort is being made to learn more about the limiting k value in relation to the diffuser and condition of the entering flow.

<u>Results with Multiple Screens</u>

Two arrangements of 40- and 30-mesh screens were attempted using the relations (6) for determining positions. These are shown in Figures 5 and 6. The choice of these screens was determined by two objectives, first to see whether by following relations (6) the overall efficiency would be zero (zero overall static pressure drop), and second to get some indication of the upper limiting k value. With these two mesh sizes it was impossible to use exactly the right number of screens, as seen by the fact that the third 40-mesh screen did not reach the end of the diffuser and the fifth 30-mesh screen extended a little beyond the end. With sufficient attention paid to the selection, the right number could have been used.

The pertinent data on these screens are as follows:

	Wire size (inch)	Solidity	k upstream 1st	2nd	3rd	4th	downstream 5th
30 mesh	0.0065	0.354	0.70	0.73	0.76	0.82	0.90
40 mesh	.0065	.453	1.17	1.25	1.39		

The effect of velocity on k value accounts for the increasing k with distance downstream.

The distribution of dynamic pressure across sections A, B, C, and D are shown in Figure 7 and 8. There is no evidence of separation in either case. The exact degree of filling is difficult to judge from these curves, but qualitatively at least the diffuser would be called "full" in both cases. The distribution of q/q_r is remarkably uniform in section D. Curve B is characteristic of distributions just ahead of a single screen or of a first screen when without screens separation would occur ahead of the screen. This shape is a manifestation of curvature of the streamlines outward toward the walls on the approach to the screen. In Figure 7 the points near the left side of curves A and B show some scatter. This generally indicates instability and may mean that the flow ahead of the first 40-mesh screen is none too well attached. With the 30-mesh screens, no unsteadiness or instability was in evidence.

For contrast, the distribution obtained without any screens in the diffuser are given in Figure 9. The flow was unsymmetrical, and separation is indicated for distributions B, C, and D. The manometer surged violently, showing evidence of a whipping of the stream from one side to the other.

Figure 10 shows the increase in the flow of potential energy, which for a uniform q across a section is the same as the static pressure rise, for 30- and 40-mesh screens and for no screens. The increase is expressed as a percentage of the incoming kinetic energy. The sudden drops occur at the screens, and the rises elsewhere are the result of diffusion. At first it was thought that values below zero were the result of using a k value corresponding to the velocity at the center rather than a properly weighted average value for the screens; but after looking into the matter further, it was found that this negative value resulted from energy losses in diffusion rather than too large drops across the screens. A large part of the loss in diffusion occurs ahead of the first screen.

Figure 11 shows the decrease in flow of kinetic energy, expressed as a percentage of the incoming kinetic energy, for the two screen arrangements and no screens, together with the theoretical decrease. Perfect agreement with the theoretical curve would mean perfect filling. The agreement indicates a close approach to filling for both the 30- and 40-mesh screens.

The efficiencies are shown in Figure 12. These are not local efficiencies but final efficiencies up to a given point corresponding to a given axial distance. The ~~final~~ end efficiency with screens is less than zero. An abrupt drop occurs at each screen, and as pointed out above, the ~~final~~ efficiency ~~is less than~~ drops below zero, not because the drops are too great, but because the diffusion is not 100 percent efficient elsewhere in the diffuser. The efficiency of the diffuser alone, as affected by the screens, was calculated from the results and is also shown in Figure 12. It will be noted that the greatest loss occurs ahead of the first screen.

Judging by the end values on the stepwise curves, at an axial distance of 36 inches in Figures 10 and 12, the 40-mesh screens seem to be the better choice. This is misleading, however, because there was too little screen present in the case of the 40-mesh and too much in the case of the 30-mesh (see last screen position, Figures 5 and 6). The diffuser efficiency is highest for the 30-mesh, and had the right amount of screen been used in both cases, the 30 mesh would have shown superior performance in every respect.

The failure to end with zero static pressure drop and zero overall efficiency shows the consequences of neglecting losses outside the plane of the screens. The question naturally arises as to how important this failure would be in practice. Figure 10 shows a loss of energy equal to about 11 percent of q_o. If a loss one q_o may be tolerated, the loss of 1.11 q_o should not be of too much concern. Actually, for this diffuser with an area ratio of 4, Figure [illegible] shows about 6 percent of q_o remaining; consequently only 1.05 q_o is lost.

Diffuser-Screen Combinations and Turbulence Reduction.

It was not intended that turbulence measurements should be made in connection with this investigation. It is realized, however, that a few such measurements would not be amiss. According to reference 3, the turbulent fluctuations are reduced on passing through a screen in the ratio

$$1/(k + 1)^{1/2}$$

and if several screens are used in tandem with a spacing of several inches or more between them, the fractional reduction over the group is

$$r = 1/(k_1+1)^{1/2}(k_2+1)^{1/2} \ldots (k_n+1)^{1/2} \qquad (9)$$

Relation (9) is true, of course, only for points far enough downstream for the fine grained turbulence from the screens to have completely decayed.

From equations (7) and (9) it follows that

$$r = A_o/A_n \qquad (10)$$

The interesting result expressed by equation (10) means that the reduction in turbulence is independent of the number of screens and the value of k, depending only on the area ratio of the diffuser, when screens are selected and positioned for zero overall pressure drop. Actually the zero pressure drop has no direct bearing on equation (10). The physical reason for equation (10) is that the screens have been placed so that the fall in mean velocity from screen to screen is just equal to the reduction in the fluctuations across a screen. For the diffuser-screen combination as a whole, the mean velocity is reduced in the same ratio as the fluctuations; consequently the percentage turbulence will be the same in the section of area A_n aft of the screens as in section o ahead of the screens. A reduction in percentage turbulence in the working chamber comes about because of the increase of mean velocity through the entrance cone, and the beneficial effect of screens appears in the larger contraction ratio made possible by the diffuser. This manner of presenting the effect of screens puts the matter in terms familiar to most engineers, since a large contraction ratio is universally recognized as one of the best ways to obtain a low-turbulence wind tunnel.

If it is assumed that a slight reduction in energy ratio of a tunnel is a matter of secondary importance, the economic aspects of diffuser-screen combinations are mainly concerned with structural costs. A given contraction ratio made possible in part by a wide-angle diffuser in the tunnel circuit involves less length of structure than the same contraction ratio obtained entirely by narrow-angle diffusers. It seems fairly obvious that structural cost should decrease along with the length. For this reason it is important to know the relation between length and area ratio of a diffuser-screen combination. This question is now being investigated.

Concluding Remarks

It should be borne in mind that relation (10), expressing the turbulence reduction in terms of an area ratio, is merely the result of an arrangement which reduces the kinetic energy per unit volume of mean flow by the same ratio as the kinetic energy per unit volume of the turbulence. As long as this condition is met, the overall change in static pressure has no direct bearing on the turbulence.

The present criterion, intended for zero static pressure drop, has been adopted rather arbitrarily. One may possibly achieve some pressure rise by judiciously omitting some of the screens and sacrificing some of the turbulence reduction, or he may achieve a greater turbulence reduction by using more screens and getting or increasing pressure drop. For example, screens could be added in the maximum section aft of the diffuser with relatively little additional pressure drop. Under these conditions the expected reduction in turbulence must be calculated by equation (9).

Throughout this treatment the effect of changing cross section on the turbulence and the natural decay have been neglected. It is interesting to observe that the attainment of low turbulence by large contraction ratio when no damping screens are used depends mainly upon factors that are here neglected.

References

1. McLellan, Charles H. and Nichols, Mark R.: An Investigation of Diffuser-Resistance Combinations in Duct Systems. NACA Advanced Restricted Report, February 1942.

2. Squire, H. B. and Hogg, H.: Diffuser-Resistance Combinations in Relation to Wind-Tunnel Design. Confidential Report No. Aero 1933, Royal Aircraft Establishment, Farnborough, April 1944.

3. The Use of Damping Screens for the Reduction of Wind Tunnel Turbulence. National Bureau of Standards Report, HLD:LJ, VI-O, Washington, D. C., August 1, 1940. (Report submitted to the NACA, unpublished)

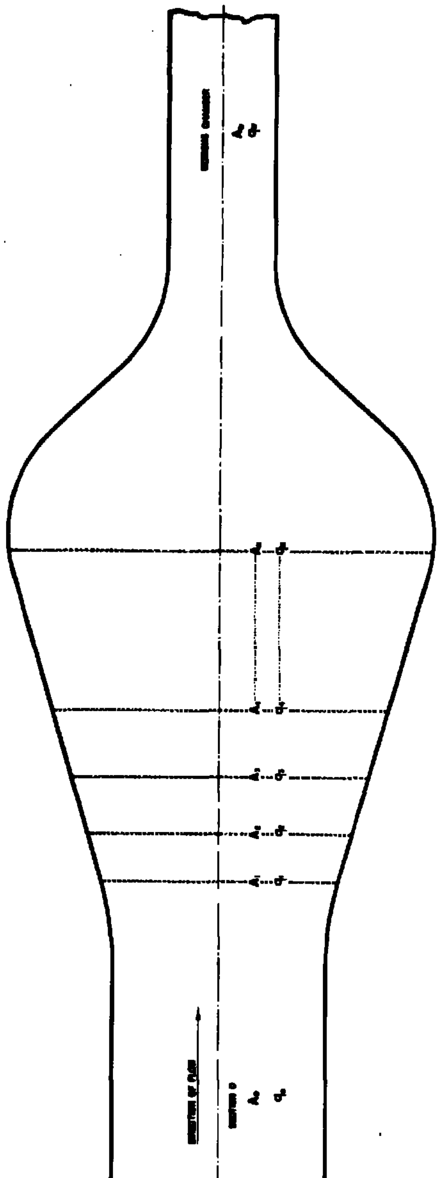


FIG. 1

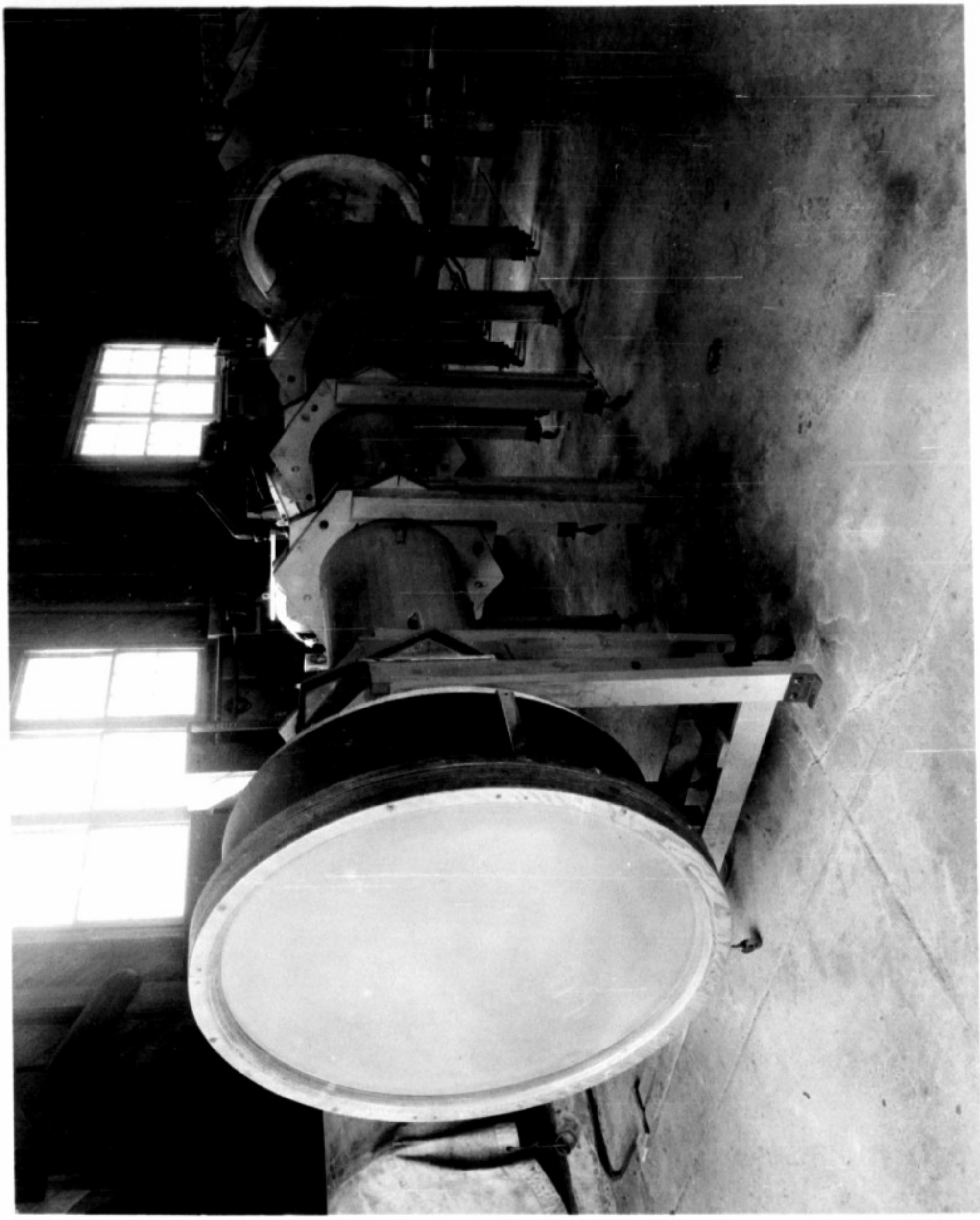


Fig.2

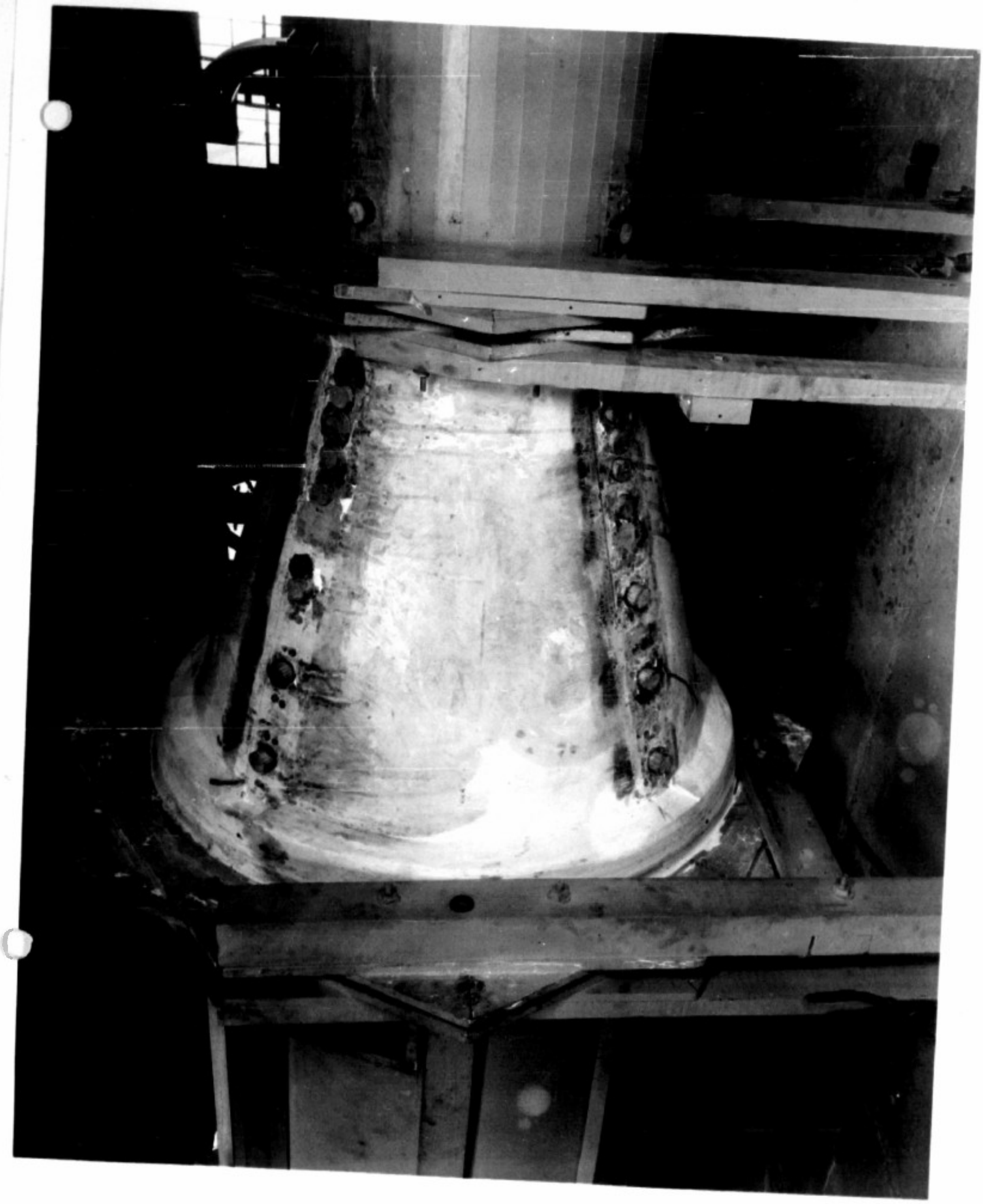
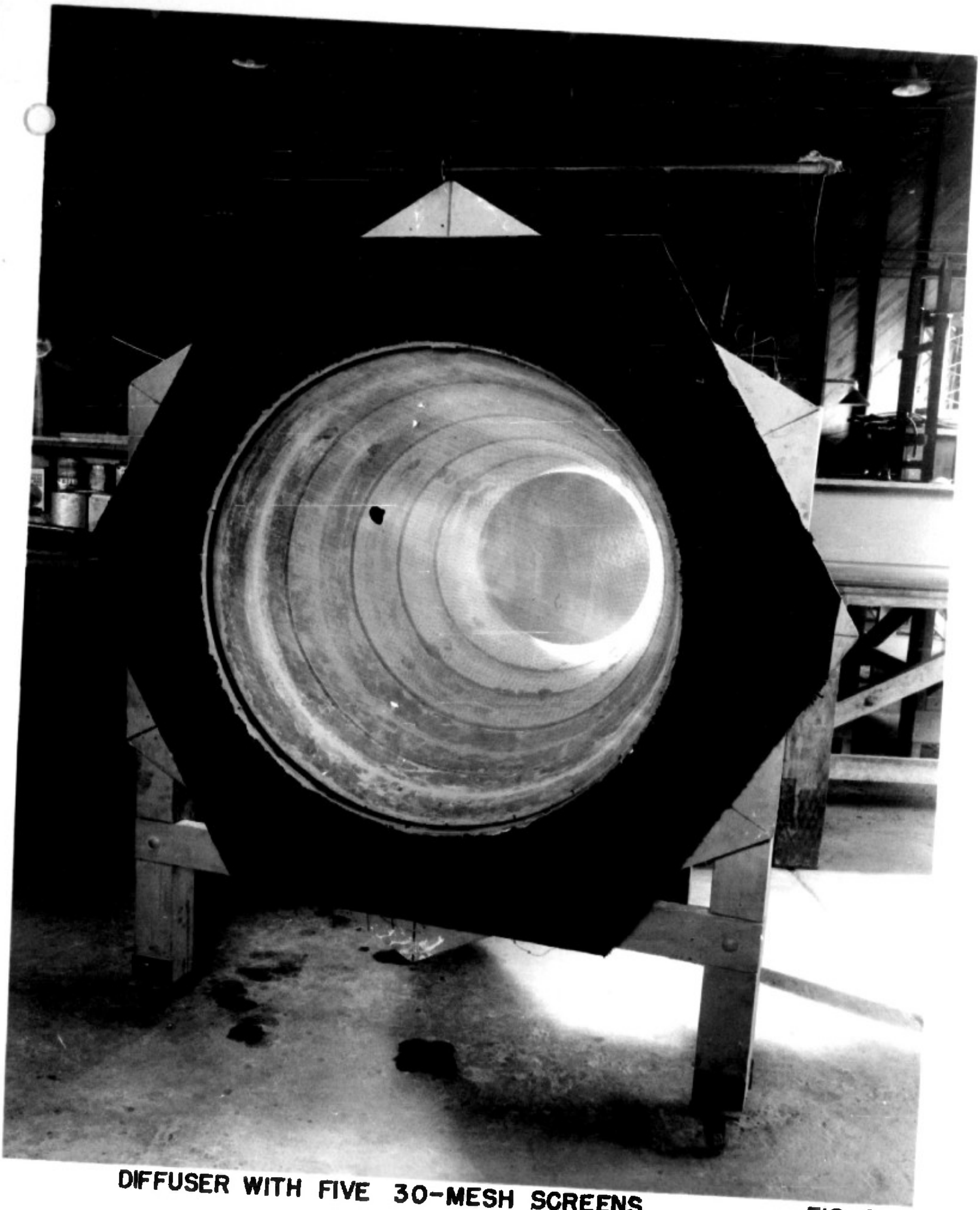
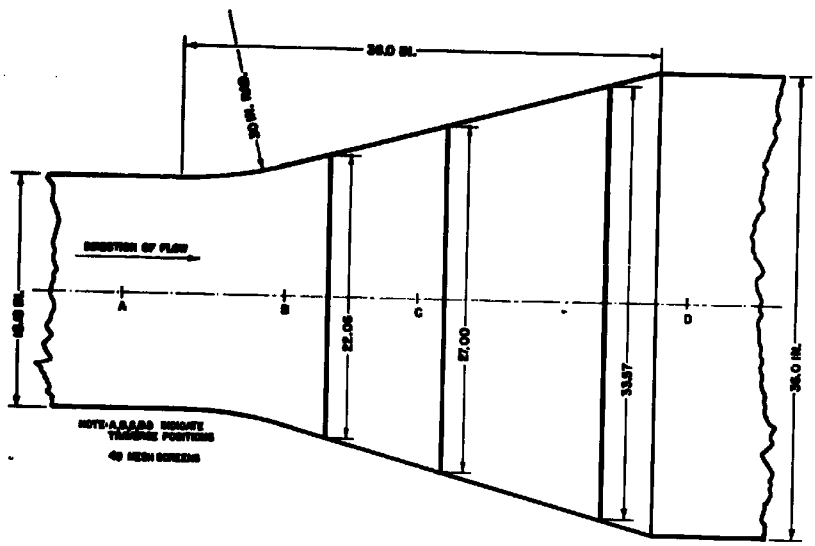


Fig.3

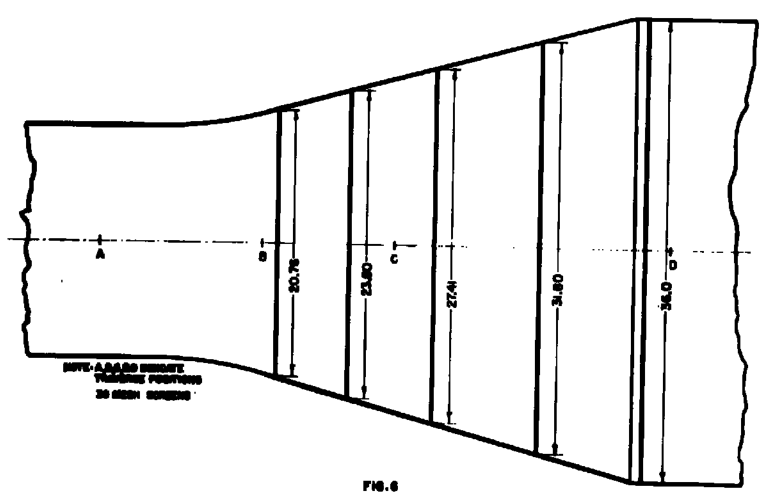


DIFFUSER WITH FIVE 30-MESH SCREENS FIG. 4



36.0 IN.
DIRECTION OF FLOW
A
B
C
D
22.06
27.00
33.57
36.0 IN.

FIG. 5



A
B
C
D
20.76
23.80
27.41
31.80
36.0

FIG. 6

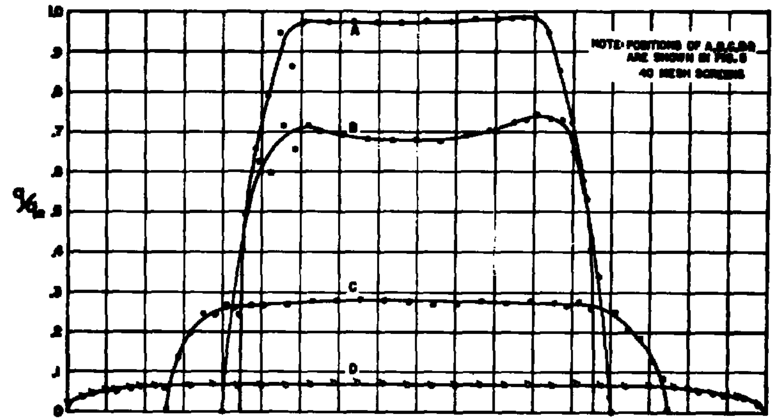

NOTE: POSITIONS OF A,B,C,&D ARE SHOWN IN FIG. 5
40 MESH SCREENS
A
B
C
D
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0

FIG. 7

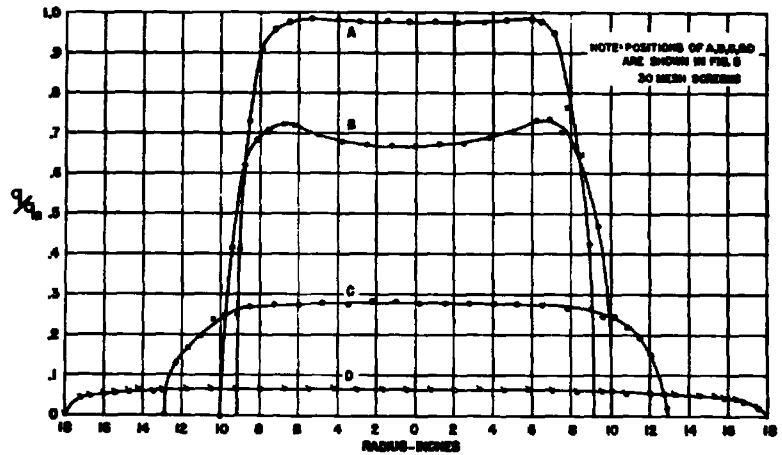

NOTE: POSITIONS OF A,B,C,&D ARE SHOWN IN FIG. 5
30 MESH SCREENS
A
B
C
D
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18
RADIUS-INCHES

FIG. 8

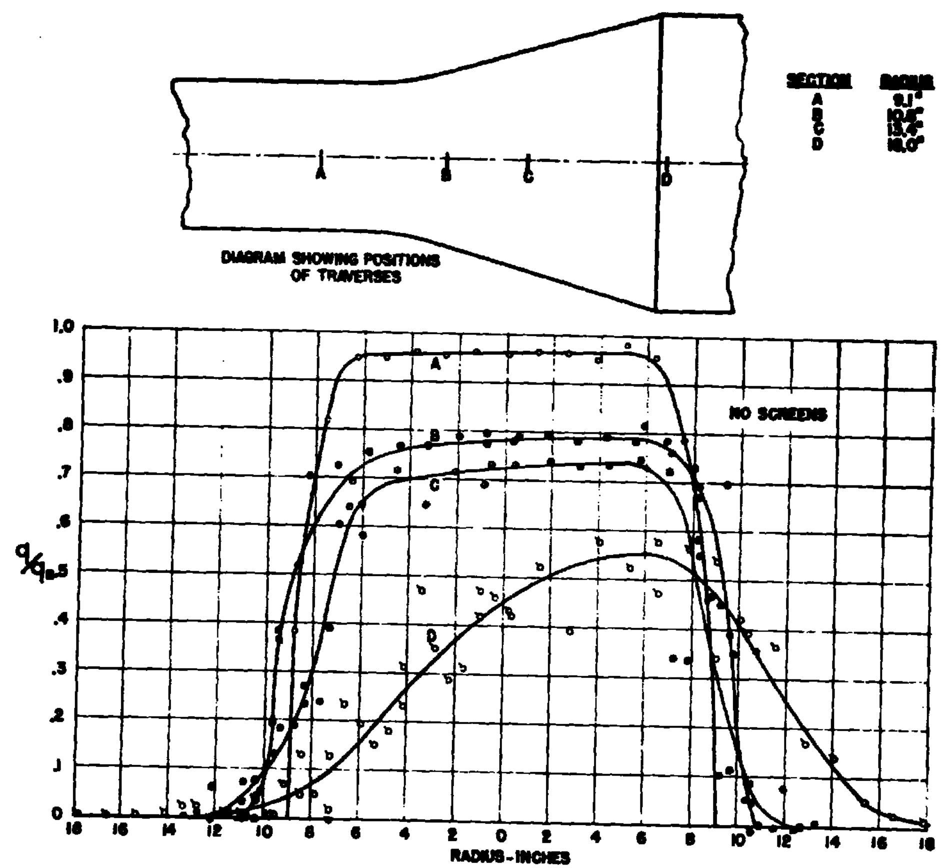

SECTION
A
B
C
D
RADIUS
9.1"
10.6"
13.4"
18.0"
A
B
C
D
DIAGRAM SHOWING POSITIONS OF TRAVERSES
NO SCREENS
q/q_a
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
0
18 16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16 18
RADIUS - INCHES

FIG. 9

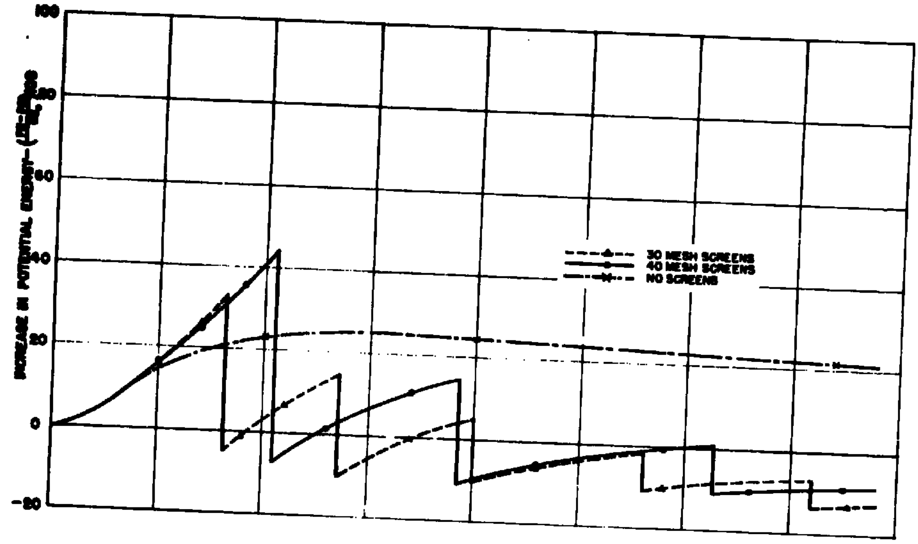

100
60
40
20
0
-20
30 MESH SCREENS
40 MESH SCREENS
NO SCREENS
DECREASE IN POTENTIAL ENERGY

FIG. 10

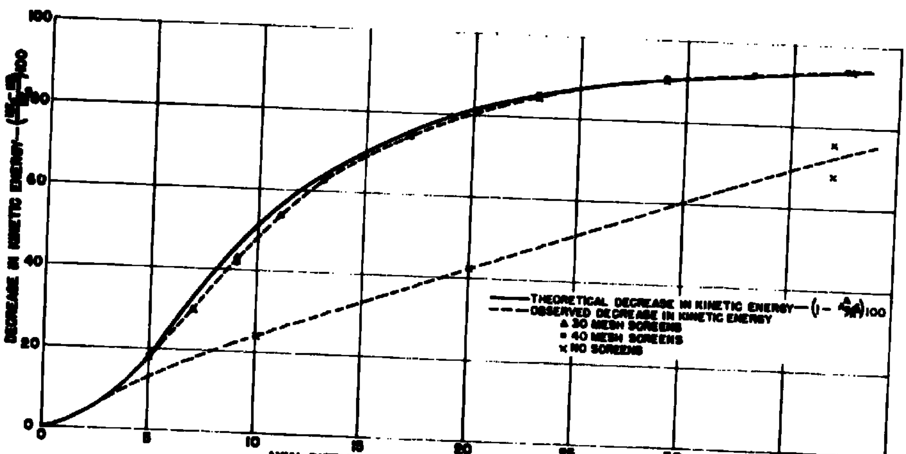
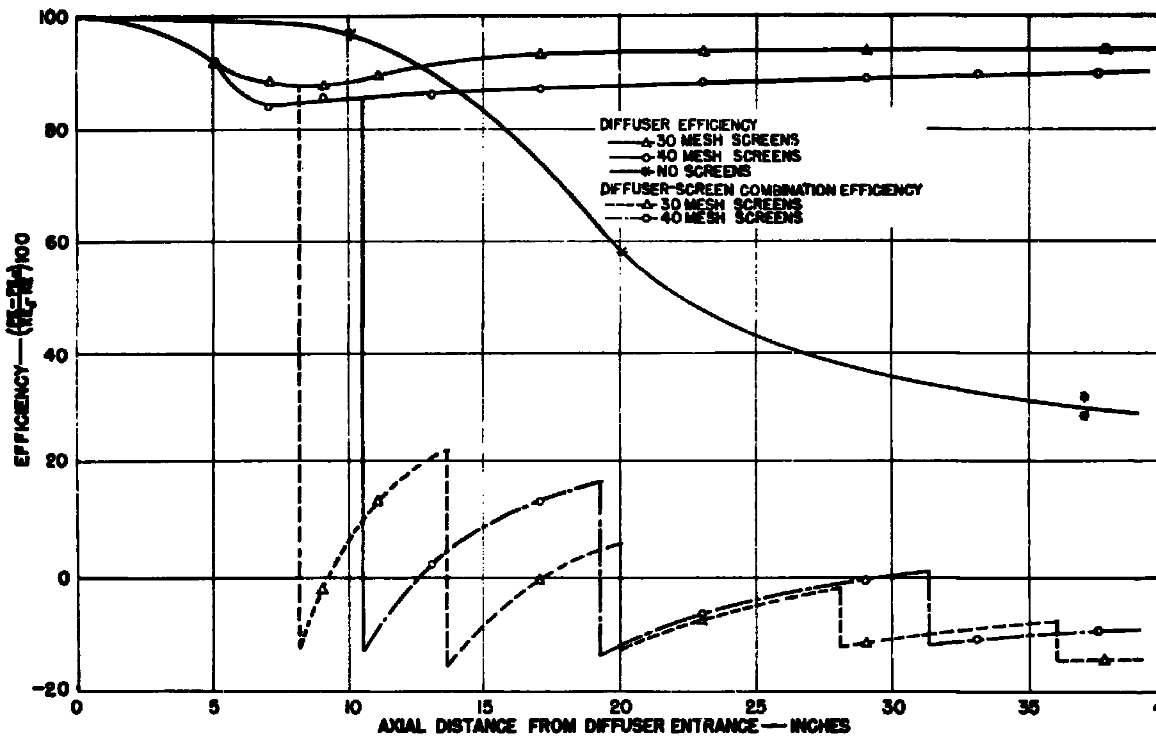

100
60
40
20
0
DECREASE IN KINETIC ENERGY
THEORETICAL DECREASE IN KINETIC ENERGY
OBSERVED DECREASE IN KINETIC ENERGY
30 MESH SCREENS
40 MESH SCREENS
NO SCREENS
0
5
10
15
20
25
30
35
40
AXIAL DISTANCE FROM DIFFUSER ENTRANCE—INCHES

FIG. 11



DIFFUSER EFFICIENCY
30 MESH SCREENS
40 MESH SCREENS
NO SCREENS
DIFFUSER-SCREEN COMBINATION EFFICIENCY
30 MESH SCREENS
40 MESH SCREENS
100
80
60
40
20
0
−20
0
5
10
15
20
25
30
35
40
AXIAL DISTANCE FROM DIFFUSER ENTRANCE — INCHES
EFFICIENCY

FIG. 12

REEL – C
263
A.T.I.
8120

CONFIDENTIAL

TITLE: Preliminary Report on Diffuser-Screen Combinations for Reducing Wind-Tunnel Turbulence	ATI- 8120
AUTHOR(S) : Schubauer, G. B.; Spangenberg, W.	REVISION (None)
ORIG. AGENCY : National Bureau of Standards, Washington, D. C.	ORIG. AGENCY NO. (None)
PUBLISHED BY : (Same)	PUBLISHING AGENCY NO. (None)

DATE	DOC. CLASS.	COUNTRY	LANGUAGE	PAGES	ILLUSTRATIONS
April '46	Confid'l	U.S.	English	30	photos, diagrs, graphs

ABSTRACT:

Experiments were conducted on single screens, diffuser-screen combinations, turbulence reduction, and effects of screens on flow in diffuser. As many screens as possible may be used consistent with allowable reduction in energy ratio of the tunnel. Arrangement of many screens with low K (pressure drop coefficient of screen) is more efficient than one of few screens with high K value. Turbulence reduction depends only on area of diffuser when screens are selected and located for zero over-all pressure drop.

DISTRIBUTION: Copies of this report obtainable from CADO (1)

DIVISION: Wind Tunnels (17)
SECTION: Design and Description (1)

SUBJECT HEADINGS: Wind tunnels - Air stream deflection (99109.4); Flow through ducts (41200); Diffusors (30200); Flow research - Installations (40700)

ATI SHEET NO.: C-17-1-1

Central Air Documents Office
Wright-Patterson Air Force Base, Dayton, Ohio

AIR TECHNICAL INDEX

CONFIDENTIAL

DEPARTMENT OF DEFENSE
WASHINGTON HEADQUARTERS SERVICES
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

APR 11 2012

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
(ATTN: WILLIAM B. BUSH)
8725 JOHN J. KINGMAN ROAD, STE 0944
FT. BELVIOR, VA 22060-6218

SUBJECT: OSD MDR Case 12-M-1566

At the request of Mr. Michael Ravnitzky, we have conducted a Mandatory Declassification Review of the attached document under the provisions of Executive Order 13526, section 3.5, for public release. We have declassified the document in full. We have attached a copy of our response to the requester. If you have any questions, contact me by e-mail at storer.robert@whs.mil, robert.storer@whs.smil.mil, or robert.storer@osdj.ic.gov or by phone at 571-372-0483.

Robert Storer
Chief, Records and Declassification Division

Attachments:
1. MDR request
2. OSD response letter
3. Document 5