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WANL-TME-715
April 1, 1964

MASTER

Test Series FFL-8

AN EXPERIMENTAL DETERMINATION OF THE
CONTROL DRUM-DRIVE SHAFT LOSS COEFFICIENTS USING AIR
(Title Unclassified)

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September 1, 1964

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NASA Lewis Research Center
21000 Brookpark Road
Cleveland 35, Ohio

Subject: WANL-TME-715, "Test Series FFL-8, An Experimental Determination of the Control Drum-Drive Shaft Loss Coefficients Using Air," dated April 1, 1964

Dear Mr. Schroeder:

Transmitted herewith are three (3) copies of the subject report. This report is transmitted for your information.

Respectfully,

H. F. Faught amw

H. F. Faught
Program Manager
NERVA Nuclear Subsystem

Enclosures (3)

cc: Mr. R. Wilke, SNPO-C Resident Office at WANL, w/o encl.
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WANL-TME-715

April 1, 1964

MASTER

Test Series FFL-8
 AN EXPERIMENTAL DETERMINATION
 OF THE CONTROL DRUM-DRIVE SHAFT
 LOSS COEFFICIENTS USING AIR
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INTRODUCTION

Pressure loss coefficients are required along the control drum and drive shaft coolant flow paths for design and off-design conditions. Flow distribution through the bearing shafts, the control drum, the flexible couplings, and the drive shaft must be determined. Measurements of the loss coefficients and flow distribution is necessary so that the correct sizing of the drive shaft discharge holes, nozzle end plenum inlet holes, nozzle end control drum plenum, and the other tortuous coolant passages can be achieved. This knowledge is necessary to insure a safe thermal environment for the control drum assembly and drive shaft innards during maximum power output of the NRX-A hot tests.

A test model that consisted of a mock-up of the center two rings of the control drum cooling holes in series with the bearing shafts and the control drum drive shaft including all necessary accessories (retaining nuts, spacers, couplings, half-rings) was fabricated, instrumented, and an air flow test program initiated. This model was designated as the J-33 model of the control drum-drive shaft. Testing on the J-33 model was halted due to changes in design philosophy regarding the nozzle end bearing shaft hole size, drive shaft design, and coupling design. Consequently, a new model was designed, fabricated, and instrumented. Its designation was the J-66 version of the control drum-drive shaft test fixture as shown in Figure 1. The test model instrumentation includes total and static pressure probes and temperature probes. The experience and knowledge gained from the instrumentation of this model can be used as a guide for the most effective utility of the available instrumentation locations of a complete control drum model which contains all of the other coolant passages such as those around the outer

zone of the control drum, around the control vane, and through the bearings and springs.

The objectives of the J-66 test model were the determination of (1) loss coefficients, (2) flow distribution, (3) effect of ring clearance, and (4) drive shaft hole size. In order to achieve these objectives a lengthy test program was required. The program can basically be divided into two separate categories. The program categories are (1) the calibration program and (2) the loss coefficient program.

The purpose of this memo is to summarize the results of the air flow experiments on the control drum-drive shaft model. These results include data from the calibration tests and the loss coefficient tests. The experiments were made using compressed air at ambient temperature and all of the results are presented in the discussion.

EXPERIMENTAL SET-UP

The air flow experiments were conducted in the Fluid Flow Laboratory. The flow loop and instrumentation are as shown in Figures 5 and 6 respectively. The gas passes through a pressure reducing valve, metering valves, the test section, and out through a measuring nozzle.

All pressure measurement stations have two static pressure taps. In the J-66 model there are 40 static pressure taps and 20 total pressure probes (Figures 1 and 1-a). Velocity profiles in the calibrated profile probe zones are obtained with total pressure probes in conjunction with static wall taps. The velocity heads and pressure drops between stations are measured with U-tube manometers. The upstream pressure of each measured pressure drop is obtained from a 0 to 160 psig range Ashcroft pressure gauge.

The gas temperature is measured at the inlet (T1) to the model and at the discharge (T2) with copper constantan thermocouples.

Flow rates are measured with a calibrated nozzle built to ASME specifications. The nozzle pressure drop is measured with a U-tube manometer and the nozzle upstream pressure is also measured with a U-tube manometer with one leg open to atmosphere.

DESCRIPTION OF MODEL

The test model (Figures 2 and 3) consists of a mock-up of the center two rings of control drum cooling holes in series with the control drum drive shaft and bearing shafts. The flow passages are accurately machined so that the cross-sectional geometry duplicates the actual flow path (plenum and coolant holes) from the nozzle end of the control drum to the actuator end of the drive shaft. All coolant holes utilize tubing to simulate flow channels wherever possible (tubing inner diameter is 0.180-inch). Due to the necessity of instrumenting the control drum-spring pocket for flow determination, it was necessary to omit the spring.

Test model flange sealing is accomplished with the use of "Mylar" gaskets (0.014-inch thick). Mylar is a polyester film produced by DuPont having relatively high strength and excellent cold temperature properties and its use as a gasket material is considered to be a fairly new innovation. A typical flange design as used in these experiments is shown in Figure 4.

The drive shaft couplings are straight splined instead of crowned. The model is complete with the dome end bearing shaft, the nozzle end bearing shaft, and all of their corresponding spacers, retaining nuts, and rings. The test model drive shaft length is one-half the actual length and the control drum length is 0.545 times the actual length. All other hardware is actual size.

During NRX-A power runs the ring clearance and plenum depth of the nozzle end bearing shaft will change due to thermal expansion. Hence there are five nozzle end bearing shafts; each shaft providing a different ring clearance and plenum depth. There are four fully instrumented drive shafts available; each drive shaft has a different exhaust hole size. The variance in the bearing shaft and drive shaft is as follows:

<u>Nozzle End Bearing Shaft</u>	1	2	3	4	5
Ring clearance (inch)	0.006	0.0498	0.1264	0.2035	0.280
Plenum depth (inch)	0.125	0.165	0.246	0.325	0.405
<u>Drive Shaft</u>	1	2	3	4	
Discharge Hole Diameter (inch)	0.200	0.250	0.300	0.350	

Flow enters the model (Figures 1, 2, and 6) at the nozzle end bearing shaft where a portion of the flow passes through a circle of eight 0.185-inch diameter holes into a small variable plenum. (Variance is achieved by the insertion of any one of the five nozzle end bearing shafts listed above.) This flow then proceeds from the plenum into an outer circle of eight 0.180-inch diameter control drum coolant tubes.

The other portion of the flow enters the nozzle end bearing shaft through a central shaft hole (17/32-inch diameter). This central shaft hole

contains calibrated profile probes which determine the flow distribution through the nozzle end bearing shaft. Since the total flow is known and the flow past the calibrated probes in the bearing shaft can be determined, the difference between these two flows will be the flow that passes through the outer circle of eight bearing shaft coolant holes.

That portion of flow discharging from the bearing shaft central hole enters the calibrated control drum spring pocket. The majority of this flow will pass through the control drum inner tubes while some of this flow will pass out over the nozzle end bearing shaft ring then into the control drum outer tubes. The amount of flow passing through the inner tubes is determined by using the spring pocket calibration data, while the flow over the ring is determined by the numerical difference between the calibrated bearing shaft flow and the calibrated spring pocket flow.

The control drum outer and inner tube coolant flow converges at the dome end of the control drum (refer Figure 7) and passes through the hollow dome end bearing shaft (0.505-inch diameter). Upon discharge from the dome end bearing shaft, some of the flow leaks out through the straight splined coupling and into a large plenum. This spline leakage is determined by subtracting the flow calculated with the use of the profile probes at the dome end of the drive shaft from the total model flow.

The remainder of the flow will exit through the drive shaft discharge holes and through the straight splined coupling at the actuator end of the drive shaft. The flow through the actuator end splined coupling is determined by the calibrated profile probes located at the actuator end of the drive shaft.

The flow discharging from the four 0.250-inch diameter drive shaft holes is determined by subtracting the flow calculated using the actuator end profile probes from the flow calculated using the dome end drive shaft profile probes. Finally all of the flow passes through a common plenum leading to the total flow measuring nozzle and then the air is exhausted to the atmosphere.

It can be seen that all of the flow can be accounted for throughout the test model by the use of the calibrated zones.

CALCULATIONS

Profile Probe Correction Factor

$$\text{CORR} = W_{\text{actual}}/W_{\text{probes}} = W/\rho A V_1 \quad (1)$$

where

CORR = correction factor for the profile probes (dimensionless)
defined as the actual flow divided by the flow past the probes

W_{actual} = actual flow (lb_m/sec). During calibration, the actual flow was equal to the total flow and this is the flow through the measuring nozzle.

A = area in which the probes are located (ft²)

$$V_1 = 18.25 \sqrt{\Delta H/\rho} \quad (2)$$

where

V_1 = average velocity through the profile probe location
area (ft/sec)

18.25 = constant with units equal to $(\text{lb}_m/\text{in. H}_2\text{O sec}^2 \text{ ft})^{\frac{1}{2}}$

ΔH = average velocity head (in. H₂O)

ρ = density of air in the probe region (lb_m/ft^3)

The flow calculation is dependent upon which section of the model is of interest. There are three (3) basic flow calculations; but combinations of the three will be used at times for the determination of loss coefficient, Reynolds number, and flow distribution.

$$W = W_1 = C_1 A_1 \left[\frac{2g \Delta P \rho r^{2/k} \left(\frac{k}{k-1} \right) \left(\frac{1-r^{\frac{k-1}{k}}}{1-r} \right)}{1 - \beta^4 r^{2/k}} \right]^{\frac{1}{2}} \quad (3)$$

$$W = W_2 = \text{CORR} (\rho A V_2) \quad (4)$$

$$W = W_3 = C_3 A_3 \sqrt{2g \rho \Delta P} \quad (5)$$

where

W = actual flow through the model at the section of interest
(lb_m/sec)

W_1 = flow through the measuring nozzle (lb_m/sec)

W_2 = flow measured by the profile probes (lb_m/sec)

W_3 = flow measured through the control drum (4) inner tubes
(lb_m/sec)

- ρ = density of air (lb_m/ft^3)
- ΔP = pressure drop (inches of water)
- g = gravitational constant ($32.2 \text{ ft lb}_m/\text{lb}_f \text{ sec}^2$)
- C_1, C_3 = flow coefficients (dimensionless)
- r = pressure ratio = downstream nozzle pressure divided by the upstream nozzle pressure (dimensionless)
- k = ratio of specific heat of the air at constant pressure divided by the specific heat of the air at constant volume
- A 's = area pertinent to that section of the flow system at which the flow is being calculated
- β = ratio of the nozzle throat diameter to the upstream pipe diameter
- V_2 = average velocity through the profile probe location area (ft/sec)
- CORR = previously defined

Calculations of the pressure loss coefficients and Reynolds numbers are based on the station location conditions.

Loss Coefficients

$$C_L = \frac{2 \rho g \Delta P A^2}{144 W^2} \quad (6)$$

where

C_L = pressure loss coefficient (dimensionless)

ρ = density evaluated at upstream loss coefficient station
pressure and temperature (lb_m/ft^3)

g = gravitational constant = $\frac{32.2 \text{ lb}_m \text{ ft}}{\text{lb}_f \text{ sec}^2}$

ΔP = pressure drop across stations being evaluated (lb_f/in^2)

A = area upon which the loss coefficient is based (in^2)

W = mass flow (lb_m/sec)

Reynolds Number

$$N_{Re} = 12 Wd/\mu A \quad (7)$$

where

N_{Re} = Reynolds number (dimensionless)

W = mass flow (lb/sec)

d = hydraulic diameter (inches)

μ = viscosity evaluated at station temperature ($\text{lb}_m/\text{sec ft}$)

A = area (square inches)

Flow Distribution

The calculation of flow distribution is performed on a percentage basis

$$\%W = \frac{W}{W_T} \times 100 \quad (8)$$

where

$\%W$ = percent of total flow through a zone (dimensionless)

W = flow through the zone of interest (lb_m/sec)

W_T = total flow through the test model (lb_m/sec)

The calculations are all performed with the use of a FORTRAN computer program designed so that those calculations (e.g., loss coefficient, loss parameter, Reynolds number) peculiar to any section of the model can be determined. The basic computer program schematic diagram and a discussion of the schematic appear in Appendix A. The FORTRAN computer program with header definitions and the resultant calculations are presented in Appendix D.

CALIBRATION PROGRAM

In order to determine the parameters—loss coefficient, Reynolds number, and percent of mass flow, it is necessary to accurately measure the mass flow rate throughout the test model. It is therefore required to calibrate many of the individual detail components of the test model structure.

For the most part the components to be calibrated were instrumented with total and static pressure probes. These probes will be referred to as "profile probes." Their purpose is to make accurate measurements of the velocity profile in the calibration zone. Hence the mass flow rate through

a particular zone can be determined by knowing the density, area, and the corrected average velocity obtained by the calibrated profile probes. The components which utilized profile probes were the nozzle end bearing shafts (5) and the drive shaft (No. 2-0.250 inch diameter discharge holes) with probes located at the actuator end and dome end.

Some of the components were calibrated by measuring the pressure and pressure drop between two sections and determining the flow coefficient. This was done where the use of profile probes would be ineffective due to the jet flow in some sections of the model. Two such sections were the control drum inner tubes and the control drum spring pocket.

Due to the important requirement for the accurate determination of loss coefficients throughout the control drum, a lengthy test period was imposed on each calibration test so that data validity could be easily ascertained. During the calibration experiments, a selected group of loss coefficients was determined, however, it should be noted that these coefficients were obtained for the calibration test configuration and conditions.

A brief description of the calibration experiments is given in Appendix B. Following is a discussion of the results of the elemental test model calibration tests.

Discussion of Calibration Results

The following discussion will be presented in three major units. The units are significant in that they define the model geometry and changes in them will alter the model configuration which in turn can affect the loss coefficients.

The units are as follows: (1) the nozzle end bearing shafts, (2) the control drum spring pocket, and (3) the drive shaft.

Nozzle End Bearing Shafts

There are five nozzle end bearing shafts each of which provides a different plenum depth and ring clearance while retaining the same geometry with respect to each other in all other aspects. At the nozzle end bearing shaft, the flow encounters its first split. Because the mass distribution is of vital necessity in the determination of loss coefficient, the shafts require instrumentation. It was decided that the central hole of the drive shaft would be instrumented with total and static pressure probes. Since a pressure traverse would be prohibitively difficult in this area during the ambient air flow and future cold hydrogen flow tests, a set of four probes was installed in each shaft hole that would describe the velocity profile. The four total probes are located as shown on Figure 8 with reference to Figure 1 at stations 20.1, 20.2, 20.3, and 20.4, and their corresponding static probe is located at either station 18.1 or 18.2. The total probes in conjunction with the static probes will be referred to as the nozzle end bearing shaft profile probes.

In order to calibrate the profile probes, the outer ring of eight bearing shaft holes were sealed so that all of the flow would pass through the central shaft hole and thereby across the profile probes and finally be measured at the measuring nozzle.

The results of the calibration are shown in Figure 13. The calibration factor or correction factor allows for the lack of the complete definition of the profile shape afforded by the four probes. In order to utilize this data in the

most expedient way in the computer program for loss coefficient calculations, a straight line equation was written for each of the bearing shaft's profile probes. The equations are as follows:

Bearing Shaft Number

1	Correction factor = 0.010555 (Head) + 1.0753
2	" " = 0.01675 (Head) + 1.0366
3	" " = 0.009473 (Head) + 1.0656
4	" " = 0.012045 (Head) + 1.07

where "Head" is the average velocity head in inches of mercury. These equations will be used when the mass distribution is determined.

In addition to the correction factor for the profile probes, loss coefficients were obtained for stations 1.1 to 2.3 while the shafts were sealed at the outer eight holes. These coefficients are presented in Figure 14. From this figure, it can be seen that the loss coefficient between these stations decreases slightly as the Reynolds number increases from 100,000 to 500,000 and that for the most part the coefficient lies between 1.2 and 1.05. The Reynolds number is based on the central shaft hole size. It appears that the change in ring clearance has little or no effect on the coefficient between these stations for the calibration configuration.

Control Drum Spring Pocket

The flow that enters the spring pocket of the control drum from the central hole of the nozzle end bearing shaft divides; the main portion going through the inner four control drum coolant holes, while a secondary portion

joins the flow entering the outer eight control drum coolant holes that passed through the outer eight nozzle end bearing shaft coolant holes. Hence it was necessary to choose a section for calibration. The section chosen was the control drum spring pocket.

The spring pocket was instrumented with two banks of four total pressure probes situated perpendicular to each other. This is shown in Figure 9. It was hoped that a meaningful velocity profile could be obtained from the flow passing through this area; however, due to the small divergence of the jet issuing from the nozzle end bearing shaft central hole, none of the profile probes (8) in the spring pocket measured a positive or useful velocity head. The jet flow was substantiated by inserting a total pressure probe in the center of the spring pocket and observing a total pressure head measurement.

It was then decided to measure the flow coefficient for the spring pocket cloverleaf and use this to determine the flow through that section of the model. This coefficient was measured between stations 4 and 5 with nozzle end bearing shafts No. 1, 2, 3, and 4 respectively; the results are shown on Figure 15, in the form of loss coefficient. Note the trend that the loss coefficient decreases as the nozzle end bearing shaft ring clearance or spring pocket plenum size increases. The flow coefficient is the inverse of the square root of the loss coefficient of equation No. 6.

The loss coefficients used for the flow calculations are as follows:

Nozzle End Bearing Shaft No.	1	2	3	4
Loss Coefficient from Station 4 to 5	1.85	1.74	1.70	1.62
Flow Coefficient $1/\sqrt{C_L}$	0.735	0.759	0.768	0.786

Finally an attempt was made to calibrate the inner control drum tubes so that any end flow effects would be minimized. Because of the large amount of data scatter obtained from these tests, it was decided to use the data from the spring pocket calibration tests (Figure 16).

The Drive Shaft

There are four drive shafts, fully instrumented, and identical in every respect with the exception of the discharge hole size. However, the drive shaft selected for testing simulated present reactor hardware.

There are two sets of profile probes in each drive shaft. One set is located upstream of the discharge holes (refer to as the dome end profile probes) and the other set is at the actuator end of the drive shaft upstream of the splines (refer to as the actuator end profile probes). These two sets of probes along with the total flow measuring nozzle make it possible to determine the flow distribution within the drive shaft. Refer Figures 10 and 11.

During calibration of the dome end profile probes, the dome end and the actuator end splines were sealed. This enabled all of the air flow to pass the probes and exit from the drive shaft through four 0.250 inch diameter discharge holes. The discharge hole loss coefficient (station 12 to 15) with the splines plugged was determined during calibration. The data for the probe calibration and the discharge hole loss coefficient is shown on Figures 17 and 18. The correction factor for the dome end profile probes is considerably less than unity. Note that the dome end bearing shaft discharge hole size is 0.500-inch in diameter. The profile probes are located within a 0.750-inch diameter section of the drive shaft and are in close proximity to the dome end bearing shaft

discharge air jet. Because of this close relationship, the issuing jet cannot diverge sufficiently for total pressure measurement by the outermost profile probes. Therefore, the two inner probes were used during calibration, yet retaining the use of the 0.750-inch diameter area. This reflects in the correction factor ($W_{\text{actual}}/W_{\text{profile probes}}$), resulting in a low correction factor with a large deviation from unity. The results are considered to be acceptable and accurate. Reference to Figure 18 shows that the loss coefficient is 1.4; however, at the higher Reynolds numbers compressibility is apparent as the loss coefficient increases.

During calibration of the actuator end profile probes, the drive shaft discharge holes and the dome end splines were sealed. This enabled all of the flow to pass by the profile probes. The data for the profile probe calibration and the loss parameter (C_L/A^2) for the actuator end of the drive shaft is shown on Figures 19 and 19A, respectively.

The correction factor equations obtained from the data and used in the computer program during loss coefficient testing were as follows:

Profile Probes

Equation

Dome End

Correction Factor = $0.006 (\text{Head}) + 0.631$

Actuator End

Correction Factor = $0.019841 (\text{Head}) + 0.9865$

Reference to Figure 19A illustrates that the loss parameter for the actuator end coupling, without its retaining nut and half rings, is on the order of 63 inches⁻⁴. Note the compressibility effects as the pressure at station location 19.1 is decreased.

LOSS COEFFICIENT PROGRAM

Using calibration data, loss coefficients were determined for the control drum-drive shaft model using nozzle end bearing shafts (NEBS) No. 1, 2, 3, and 4, and drive shaft No. 2 at the following J-66 locations:

Nozzle end bearing shaft central hole	(1.1-2.3)
Nozzle end bearing shaft outer (8) holes	(1.1-2.1)
Nozzle end control drum composite	(1.1-3.1)
Nozzle end ring clearance	(2.4-2.2, 2.3-3.1)
Control drum cloverleaf	(4.1-5.1)
Control drum inner (4) tubes	(4.1-7.1, 5.1-7.1)
Control drum outer (8) tubes	(2.1-9.1, 3.1-9.1, 2.1-3.1)
Dome end bearing shaft	(7.1-10.1)
Dome end bearing shaft discharge hole	(10.1-12.1)
Dome end coupling (C_L/A^2)	(10.1-15.1, 11.1-15.1)
Actuator end coupling (C_L/A^2)	(19.1-16.1)
Drive Shaft No. 2 discharge holes (4)	(12.1-15.1)

The loss coefficients will be discussed for each of the above, and in many of the cases the loss coefficients obtained during the plugged calibration tests will be presented for comparison.

DISCUSSION OF RESULTS

The following discussion details the flow interactions between the nozzle end bearing shaft and the control drum. A general picture of the flow distribution is presented, then more specifically an explanation of why the distribution is as it is.

The flow distribution through the nozzle end bearing shaft and the control drum during the unplugged loss coefficient tests can be seen on Figs. 20, 21, and 22. The curves are based on the Reynolds number of the air flow through the nozzle end bearing shaft central hole.

Air flow passes through the nozzle end bearing shaft (NEBS) central hole and outer (8) holes. The central hole air flow splits upon leaving the central hole, some going on through the control drum (4) inner holes (spring pocket discharge) and some passing over the NEBS ring and into the control drum (8) outer holes. The NEBS outer (8) hole flow enters a small plenum, then passes into the control drum outer (8) holes along with the partial flow that split off the central NEBS hole discharge flow.

The mechanics of the NEBS central hole flow split appears to be as follows (refer Figure 12):

1. Jet air flow discharges from NEBS.
2. The air jet impinges on the control drum spring pocket cloverleaf.
3. It splashes out along the cloverleaf face.
4. The main flow turns into the control drum inner tubes.
5. The secondary flow splashes out along the spring pocket wall.
6. This rearward flow spills out of the spring pocket and flows radially outward over the NEBS ring, then into the control drum outer (8) holes.

This theory was substantiated to some extent by making total pressure measurements within the spring pocket, and noting negative pressure readings which indicated recirculation.

Figure 20 illustrates that for a ring clearance of 0.006 inches, the NEBS average flow split between the central hole and the outer (8) holes is approximately 52.5% - 47.5% respectively. Note that the NEBS areas are approximately equal (0.531 inch diameter vs 8 - 0.185 inch diameter) and that the flows deviate more as Reynolds number increases.

When the ring clearance is increased to 0.0498 and 0.1264 inches, the central hole flow takes a slightly larger portion of the total flow; however, when the clearance is increased to 0.2035 inches, the NEBS central hole flow drops off slightly.

Reference to Figure 21 shows that the flow distribution through the control drum closely maintains a similar flow relationship between the inner (4) control drum holes and the outer (8) control drum holes regardless of NEBS ring clearance or Reynolds number for the range tested. Hence the flow distribution through the control drum does not depend on the NEBS ring clearance.

Again make reference to Figure 22 and observe that the NEBS ring clearance flow is lower for the case of the 0.006-inch clearance (NEBS 1) than for the other higher ring clearance flow cases. Note that the NEBS ring clearance flow increases for a given Reynolds number when the clearance is increased to 0.0498 (NEBS 2) and 0.1264 inches (NEBS 3), but starts to decrease as the clearance increases further (NEBS 4); however, it never reaches as low a spillage flow as for the 0.006-inch case.

The NEBS ring can be thought of as a single stage labyrinth seal, although a very inefficient one. Its inefficiency is primarily due to (1) the turbulent condition at its inlet, (2) the chamfer at the ring inlet (ID) and the outlet (OD) causing it to behave somewhat like a nozzle, and (3) the thickness of the seal lip.

The reasons for the low leakage at the small clearance of 0.006 inch are as follows: (1) low clearance area, (2) laminar boundary layer built up across the ring lip face resulting in a still lower effective area, and (3) friction effects.

The primary reason for the higher leakage at the higher clearances of 0.0498 and 0.1264 inch is the increased flow area.

The reasons for the decreasing flow when the ring clearance was increased to 0.2035 inches are as follows: (1) boundary layer conditions resulting from the slightly increased jet expansion due to the backing away by the NEBS from the spring pocket, (2) ring approach conditions, and (3) changing NEBS ring discharge plenum conditions resulting from the increased expansion of the NEBS outer (8) hole discharge flow.

The loss coefficients for the nozzle end bearing shaft and the control drum will now be discussed in detail.

Nozzle End Bearing Shaft Inner (central) Hole (Loss Coefficient from 1.1 - 2.3)

The loss coefficient obtained during the plugged calibrations tests (Figure 14) is higher than for the unplugged loss coefficient tests (Figure 23). Examination of the curves indicates that the calibration data yields loss coefficients in the range of 1.2, while the unplugged loss coefficient data yields loss coefficients in the range of 0.775.

There is an unusual amount of data scatter for the unplugged tests. This is attributed to the turbulent backwash from the spring pocket area which may change for every flow setting change, thus adversely affecting the pressure measurement at the 2.3 and 2.4 station location. As noted previously during the unplugged tests, radial outward flow across the nozzle end ring existed and since the 2.3 pressure tap was located parallel to the radial flow direction, a higher pressure measurement likely existed; therefore, a lower differential pressure between station locations 1.1 and 2.3. The lower coefficient obtained during the unplugged flow tests could well result from this slight total pressure reading at the 2.3 station location and the resulting lower differential pressure.

The true loss coefficient for the central hole of the NEBS would likely be obtained during the plugged flow tests. It appears that the static pressure measurements during these tests were true static measurements. It appears that the loss coefficient has no significant dependence on the ring clearance for the case of the central NEBS hole.

Nozzle End Bearing Shaft Outer (8) Holes (Loss Coefficient from 1.1 to 2.1)

Figure 24 illustrated the loss coefficient data versus Reynolds number. The loss coefficient and the Reynolds number are based on the 0.185-inch diameter holes. The loss coefficient varies between 1.25 and 1.75 for Reynolds numbers between 3×10^4 and 1.3×10^5 . The plenum downstream of the NEBS outer (8) holes is another difficult location at which to measure pressure. This is so because of the flow interactions in this area. Flow enters this area from across the NEBS ring along with the NEBS outer (8) hole flow. It appears that measuring a true static pressure in this area is a difficult task and since the pressure drop

across these holes is so small, large variations in calculated loss coefficient can be obtained with even the smallest disturbance in the flow at the 2.1 and 2.2 pressure tap locations. At low flow the pressure drops measured are lower than $1/4$ of a pound per square inch, and the maximum possible error is estimated to be 49%.

Composite Loss Coefficient for Nozzle End Bearing Shaft & Control Drum (1.1-3.1)

A lumped loss coefficient from the model inlet station 1.1 to just inside the control drum outer (8) holes was obtained as shown on Figure 25. This coefficient is a combination of the losses through the nozzle end bearing shaft outer (8) holes, the interaction losses upon discharge from these holes with the ring clearance flow, and the contraction losses of the flow upon entering the outer (8) control drum flow holes. The area upon which the loss coefficient and Reynolds number is based is that of the control drum outer (8) holes (0.180-inch diameter). It appears that there is no decisive trend for the variance in ring clearance and nozzle end plenum depth. Recall that the percent of the total flow through the control drum remained constant for a given Reynolds number regardless of the NEBS clearance conditions. A representative loss coefficient for Reynolds numbers between 3×10^4 and 1.3×10^5 is 1.62 despite any of the above mentioned NEBS changes.

Loss Coefficient for the Nozzle End Ring (2.3-3.1 and 2.4-2.2)

The nozzle end bearing shaft ring clearance loss coefficient and Reynolds number are based on the ring clearance at the 1.5 inch diameter. Since there are four nozzle end bearing shafts that provide different ring clearances,

there are consequently four different flow areas. The dimensions used are as follows:

<u>Nozzle End Bearing Shaft</u>	<u>Ring Clearance Area</u>	<u>Hydraulic Diameter</u>	<u>Clearance</u>
1	0.0302	0.0128	0.0064
2	0.234	0.0996	0.0498
3	0.596	0.2528	0.1264
4	0.959	0.4070	0.2035

However, for the case of the loss coefficient from 2.3 to 3.1, the pressure drop from the 2.3 to 3.1 pressure measurement station location is used while the appropriate ring clearance area listed above and the ring clearance flow is used. The ring clearance flow is calculated by taking the difference between the NEBS central hole flow and the control drum spring pocket flow. For the case of the loss coefficient from 2.4 to 2.2, the pressure drop from 2.4 to 2.2 is used, while once again the appropriate ring clearance area listed above and the ring clearance flow is used.

The loss coefficients for stations 2.3 to 3.1 are shown on Figure 26. It can be seen that as the clearance increases the loss coefficient consequently increases. The data for each NEBS exhibits a slight downward trend. The reason for the downward trend for the individual coefficients is because the flow across the NEBS ring is calculated using the difference between the increasing correction factor of the NEBS central hole and the constant flow coefficients of the control drum inner (4) hole flow. The result of which yields flow rates which may be slightly higher than they ought to be due to the possibility of error in the positively sloped calibration correction factors, this in turn gives a decreasing loss coefficient as Reynolds number increases.

For Reynolds numbers between 1×10^4 and 3×10^4 the loss coefficients and the loss parameters (C_L/A^2) are as follows:

<u>NEBS</u>	<u>Loss Coefficient</u>	<u>Loss Parameter</u>
1	0.37- 0.33	405 - 359
2	12.0 - 10.6	219 - 193
3	64.0 - 59.5	180 - 167
4	225.0 -196.0	245 - 213

The loss coefficient from station location 2.4 to 2.2 can be seen on Figure 27. The data exhibits a slight downward trend the same as that for the loss coefficients from 2.3 to 3.1 and for the same reason. There was an excessive amount of data scatter during testing of NEBS 3 for the loss coefficient from 2.4 to 2.2, therefore this is not shown on the figure. This data can be seen in Appendix A.

For Reynolds numbers between 1×10^4 and 3.2×10^4 the loss coefficient and the loss parameter (C_L/A^2) are as follows:

<u>NEBS</u>	<u>Loss Coefficient</u>	<u>Loss Parameter</u>
1	0.10 - 0.096	109.6 - 105.2
2	0.74 - 0.64	13.5 - 11.7
4	4.65 - 4.62	5.06- 5.03

Control Drum Cloverleaf (4.1 - 5.1)

During the unplugged flow tests the calculated control drum cloverleaf loss coefficients are constant and the same as those obtained during the plugged

calibration tests (Figure 15). It was these constant numbers what were used for the determination of the flow coefficients used in the calculation of the flow through the central four holes of the control drum. A summary of the loss coefficients is as follows:

NEBS	Loss Coefficient (4.1-5.1)	Reynolds Number
1	1.85	$2 \times 10^5 - 8.2 \times 10^5$
2	1.74	$2 \times 10^5 - 8.2 \times 10^5$
3	1.70	$2 \times 10^5 - 8.2 \times 10^5$
4	1.62	$2 \times 10^5 - 8.2 \times 10^5$

The reason for the decreasing loss coefficients for increasing ring clearance is attributed primarily to the effect of the jet impingement and the resultant losses due to turning into the inner (4) control drum tubes.

Control Drum Inner Tubes (4.1 - 7.1, 5.1 - 7.1)

Figure 28 illustrates the loss coefficients from station 4.1 to 7.1 and from 5.1 to 7.1 for nozzle end bearing shaft numbers 1, 2, 3, and 4.

For a given flow or Reynolds number the tendency toward compressibility increases as the upstream density decreases. The density decrease is a consequence of pressure decrease, which results from the additional flow area or bleed-off area caused by the increased ring clearance as NEBS 1, 2, 3, and 4 are interchanged. Reference to Figure 28 shows the trend that if the ring clearance increases, the loss coefficient decreases. The loss coefficient for NEBS No. 1

appears to be misplaced since it is lower than the loss coefficient for NEBS No. 2. However, the pressure drops from 4.1 to 7.1 and 5.1 to 7.1 for the No. 1 NEBS are lower than the No. 2 NEBS because of the condition of the jet impingement and other surrounding flow conditions upon entry from the spring pocket to the control drum inner tubes. Note, as would be expected, that the loss coefficient from 4.1 to 7.1 is larger than the loss coefficient from 5.1 to 7.1 for any given NEBS.

The loss coefficients 4.1 to 7.1 and 5.1 to 7.1 are based on the area of the four 0.180-inch diameter tubes. The loss coefficients at a Reynolds number of 7×10^4 are as follows:

NEBS	Loss Coefficient (4.1 - 7.1)	Loss Coefficient (5.1 - 7.1)	Difference
1	3.88	2.35	1.53
2	3.85	2.36	1.49
3	3.62	2.20	1.42
4	3.27	1.925	1.345

In order to check the results from stations 4.1 - 7.1 and 5.1 - 7.1 with the input and consequent output for station 4.1 - 5.1 we can derive the following equation:

$$C_{L4-7} - C_{L5-7} = C_{L4-5} \left(\frac{D_{0.180}}{D_{0.1875}} \right)^4 \left(\frac{\Delta P_{4-7}}{\Delta P_{4-5}} - \frac{\rho_5 \Delta P_{5-7}}{\rho_4 \Delta P_{4-5}} \right) \quad (9)$$

where

C_{L4-7} , C_{L5-7} , C_{L4-5} = loss coefficients for the subscripted locations (non-dimensional)

$D_{0.180}$, $D_{0.1875}$ = diameters equal to 0.180" and 0.1876" respectively (inches)

ΔP_{4-7} , ΔP_{5-7} , ΔP_{4-5} = pressure drop at the subscripted locations (lb_f/in²)

ρ_5 , ρ_4 = density at station location of the subscript (lb_m/ft³)

Now, since the difference in densities between station location 4.1 and 5.1 are slight, we can simplify Equation 9 to the point where we can multiply the loss coefficient from 4.1 to 5.1 by the fourth power of the ratio of the diameter for the 4-7 and 5-7 coefficient (0.180-inch dia) to the diameter for the 4-5 coefficient (0.1875-inch dia). The constant arrived at for this ratio is 0.854 and the relationship for Equation 9 reduced to

$$C_{L4-7} - C_{L5-7} = 0.845 C_{L4-5} \quad (10)$$

The loss coefficients presented above are good representations for stations 4.1 to 7.1 and 5.1 to 7.1, since the loss coefficient from stations 4.1 to 5.1 (Page 21 and Fig. 15) when multiplied by 0.845 very closely equals the difference between 4.1-7.1 and 5.1-7.1.

Loss Coefficient for the Control Drum Outer Eight Tubes

Loss coefficients from station locations 2.1 to 9.1 and 3.1 to 9.1 are based on the flow through the outer (8) control drum tubes and the diameter of the tubes (0.180-inch dia). These loss coefficients are shown on Figure 29. It appears that for Reynolds numbers between 4.5×10^4 and 8×10^4 that the loss coefficients from stations 2.1 to 9.1 using NEBS 1, 2, 3, and 4 are 3.4, 3.5, 3.65, and 3.75 respectively, while the loss coefficients from stations 3.1 to 9.1 using NEBS 1, 2, 3, and 4 are 2.7, 2.75, 2.8, and 2.9 respectively. It is shown that compressibility begins to appear at Reynolds numbers in excess of 8×10^4 . With the exception of the case employing NEBS 1; compressibility effects are not as abrupt as the plenum size increases just downstream of the NEBS outer (8) holes. In other words, compressibility is seen to occur first with NEBS 2, then so on with NEBS 3 and 4. There do not appear to be any compressibility effects while using NEBS 1.

Since the area and flow is the same for loss coefficients 2.1 to 9.1, 3.1 to 9.1, and 2.1 to 3.1, and since the densities at station locations 2.1 and 3.1 are very similar, the difference between the coefficients 2-9 and 3-9 are convenient checks on the validity of the coefficient obtained for 2.1 to 3.1. An estimate of the difference between 2-9 and 3-9 loss coefficient for Reynolds numbers between 4.5×10^4 and 8×10^4 for NEBS 1, 2, 3, and 4 is 0.70, 0.75, 0.85, and 0.85 respectively. Reference to Figure 30 will show that this is in pretty good agreement. Note that the loss coefficient obtained using NEBS 1 is lower than that obtained for NEBS 2, 3, and 4. The reason for this is due primarily because of the lower flow interaction, since the ring clearance flow is less in the case of the No. 1 NEBS.

Flow Distribution in Drive Shaft No. 2

Flow discharges from the drive shaft through the dome end coupling splines, the actuator end coupling splines, and the four 0.250-inch diameter discharge holes. The percent of total flow for each of the discharge areas is plotted versus the Reynolds number at Station locations 10.1 on Figure 31.

At low flows the air discharges from the dome end bearing shaft, then the major portion of the flow discharges from the shaft through the four discharge holes while secondary flow turns out through the dome end coupling splines and down and out through the actuator coupling splines as shown on the figure. However, as the total flow increases, the percentage of flow turning out through the dome end coupling splines decreases, while the percent of flow that carries on down the hollow drive shaft maintains a fairly constant percentage. The result of these two conditions enables more of the total percent of the flow to exit through the four drive shaft discharge holes. At the highest Reynolds number tested, it is shown that the percent of the total flow through the dome end splines drops off to 2%, the percent of the total flow through the actuator end splines holds at about 18%, and the drive shaft discharge hole flow increases to about 80%.

Loss Coefficient for Drive Shaft No. 2 (12.1 - 15.1)

Figure 32 illustrates the data obtained during the unplugged flow tests compared with the straight line (Figure 18) obtained during the plugged calibration flow tests. Refer back to Figure 32 for the source of the straight line comparison. The data is in good agreement despite flow interactions with the dome end spline leakage. The loss coefficient is 1.4 for Reynolds numbers between 1.1×10^5 and 3.7×10^5 .

Dome End Bearing Shaft Loss Coefficient from 7.1 to 10.1

This loss coefficient is based on the pressure at station location 7.1 which is located on the face at the dome end of the control drum, the pressure drop from 7.1 to 10.1, the area of the discharge hole (0.505-inch diameter), and the flow through this hole which is 100% of the total. The loss coefficient is 1.65 for Reynolds numbers between 2.35×10^5 and 5×10^5 . Above Reynolds number 5×10^5 compressibility effects are present. This can be seen on Figure 33.

Loss Coefficient for Dome End Bearing Shaft Discharge Hole (10.1 - 12.1)

This loss coefficient is based on the area of the discharge hole (0.505-inch diameter), the pressure at the 10.1 station location and the pressure drop from 10.1 to 12.1. Station location 12.1 is just upstream of the drive shaft discharge holes, but downstream of the dome end coupling through which some flow will escape. The 10.1 to 12.1 section acts as a diffusion piece and therefore the pressure will rise causing a negative loss coefficient. The loss coefficient and Reynolds number is based on the flow through the bearing shaft which is 100% of the total flow. Reference to Figure 34 shows that the loss coefficient varies between -0.5 and -0.6 for Reynolds numbers between 3.0×10^5 and 10^6 . Figure 35 based on all of the above, with the exception that N_{Re} and flow is based on the flow past station 12.1, shows that the loss coefficient is -0.665 for N_{Re} between 2.7×10^5 and 9.0×10^5 .

Loss Coefficient from Station 7.1 to 12.1

This loss coefficient and its Reynolds number is based on the area of the dome end bearing shaft discharge hole (0.505-inch diameter), the total

flow through the bearing shaft, and the pressures at station locations 7.1 and 12.1. Note that the loss coefficient from 7.1 to 10.1 is a positive one (pressure drop) while the loss coefficient from 10.1 to 12.1 is a negative one (pressure rise), however, the composite or lumped coefficient from 7.1 to 12.1 is a resultant positive coefficient. For Reynolds numbers between 2.5 and 5.5×10^5 at the 10.1 location, the loss coefficient is 1.1 (Figure 36).

Loss Through the Splined Coupling at the Actuator End of Drive Shaft No. 2

This loss is measured between station 19.1 and 16.1. Since the leakage area cannot be accurately determined, the parameter loss coefficient divided by area squared was calculated. This is shown in Figure 37 and is found to vary between 530 and 850 for N_{Re} based on the flow at 10.1 between 3.2×10^5 and 9.5×10^6 . A representative loss parameter would be 630 inches⁻⁴ based on this data. This was determined for the condition when the half ring and retaining nut are in place on the coupling.

Loss Through the Splined Coupling at the Dome End of Drive Shaft No. 2

Figures 38 and 39 show the results of the loss from station locations 10.1 to 15.1 and 11.1 to 15.1 respectively. This loss parameter is the same type as mentioned above. It can be seen by comparing the data that the loss is slightly greater for the 10.1 to 15.1 case than the 11.1 to 15.1 case. The reason for the rapid increase in loss is due primarily because the pressures at the points measured are somewhat independent of the flow through the splines since the large plenum pressure is a result of flow from three different sources and the flow through the splines decreases to almost zero at high dome end bearing shaft flows, thereby decreasing the denominator, hence increasing the loss calculation.

CONCLUSIONS

1. The flow distribution through the 12 control drum holes (inner (4) control drum holes and the outer (8) control drum holes) is about equal regardless of the nozzle end bearing shaft ring clearance or Reynolds number for the range tested. Figure 21.
2. A change in nozzle end bearing shaft ring clearance affects the flow distribution through the nozzle end bearing shaft and across the ring. Figure 22.
3. The major portion of the flow (between 70 and 80 percent of the total flow) discharging from the drive shaft, discharges through the four 0.250 discharge holes. Figure 31.
4. The loss coefficient for the nozzle end bearing shaft central hole from station location 1.1 to 2.3 for Reynolds numbers between 1×10^5 and 5×10^5 is 1.2 for the plugged calibration tests and 0.775 for the unplugged flow tests.
5. The loss coefficient for the nozzle end bearing shaft outer (8) holes from station location 1.1 to 2.1 varies between 1.25 and 1.75 for Reynolds numbers between 3×10^4 and 1.3×10^5 .
6. The composite loss coefficient for the nozzle end bearing shaft and control drum from station location 1.1 to 3.1 varies between 1.5 and 1.8 between Reynolds numbers 1×10^4 and 3.7×10^4 .
7. The loss coefficients and loss parameters (C_L/A^2) for Reynolds numbers between 1×10^4 and 3×10^4 for station locations 2.3 to 3.1 are as follows:

<u>NEBS</u>	<u>Loss Coefficient</u>	<u>Loss Parameter</u>
1	0.37 - 0.33	405 - 359
2	12.0 - 10.6	219 - 193
3	64.0 - 59.5	180 - 167
4	225.0 - 196.0	245 - 213

8. The loss coefficients and loss parameters (C_L/A^2) for Reynolds numbers between 1×10^4 and 3.2×10^4 for station locations 2.4 to 2.2 are as follows:

<u>NEBS</u>	<u>Loss Coefficient</u>	<u>Loss Parameters</u>
1	0.10 - 0.096	109.6 - 105.2
2	0.74 - 0.64	13.5 - 11.7
4	4.65 - 4.62	5.06 - 5.03

9. The loss coefficient for the control drum from station locations 4.1 to 5.1 obtained from the plugged calibration tests, also the input during the unplugged flow tests for use as flow coefficients are as follows:

<u>NEBS</u>	<u>Loss Coefficient</u>	<u>Reynolds Number</u>
1	1.85	2×10^5 - 8.2×10^5
2	1.74	2×10^5 - 8.2×10^5
3	1.70	2×10^5 - 8.2×10^5
4	1.62	2×10^5 - 8.2×10^5

10. The loss coefficient for the control drum inner tubes from station locations 4.1 to 7.1 and from station location 5.1 to 7.1 at a Reynolds number 7×10^4 are as follows:

<u>NEBS</u>	<u>Loss Coefficient (4.1-5.1)</u>	<u>Loss Coefficient (5.1-7.1)</u>
1	3.88	2.35
2	3.85	2.36
3	3.62	2.20
4	3.27	1.925

11. The loss coefficients for the control drum (8) outer tubes from stations 2.1 to 9.1 and from 3.1 to 9.1 for Reynolds numbers between 4.5×10^4 and 8×10^4 are as follows:

<u>NEBS</u>	<u>Loss Coefficient (2.1-9.1)</u>	<u>Loss Coefficient (3.1-9.1)</u>
1	3.40	2.70
2	3.50	2.75
3	3.65	2.80
4	3.75	2.90

12. The loss coefficient for the control drum outer (8) holes from station locations 2.1 to 3.1 for Reynolds numbers between 4.5×10^4 and 2×10^5 are as follows:

<u>NEBS</u>	<u>Loss Coefficient (2.1-3.1)</u>
1	0.77 - 0.83
2	0.80 - 1.15
3	0.85 - 1.18
4	0.90 - 1.15

13. The loss coefficient for the drive shaft discharge holes from station location 12.1 to 15.1 is 1.4 between Reynolds numbers 1×10^5 and 1.9×10^6 using data from both the plugged and unplugged flow tests.

14. The loss coefficient for the dome end bearing shaft for station location 7.1 to 10.1 is 1.65 between Reynolds numbers 2.3×10^5 and 5.2×10^5 .

15. The loss coefficient for the dome end bearing shaft discharge hole from station location 10.1 to 12.1 varies from -0.5 to -0.6 for Reynolds numbers between 3×10^5 and 10^6 . The Reynolds number and flow is based on the conditions at the 10.1 location.

16. The loss coefficient for the dome end bearing shaft discharge hole from station location 10.1 to 12.1 is -0.665 for Reynolds numbers between 2.2×10^5 and 10^6 . The Reynolds number and flow is based on the conditions at the 12.1 location.

17. The loss coefficient for the dome end bearing shaft from station location 7.1 to 12.1 is 1.1 for Reynolds numbers between 2.5 and 5.5×10^5 at the 10.1 location.

18. The loss parameter for the dome end coupling from station locations 10.1 to 15.1 and 11.1 to 15.1 for Reynolds numbers at location 10.1 between 2×10^5 and 6.8×10^5 is 27 inches⁻⁴ and 24 inches⁻⁴ respectively.

19. The loss parameter for the actuator end coupling from station location 19.1 to 16.1 for the unplugged flow tests was 630 inches⁻⁴ for Reynolds numbers at the 10.1 location between 3.5×10^5 and 7×10^5 . The coupling had the retaining nut and the half rings installed. The loss parameter for the plugged calibration tests was 63 inches⁻⁴, but this was without the retaining nut and

and half rings. In neither of the two tests was the splined shaft butted up against the splined coupling.

RECOMMENDATIONS:

A number of loss coefficients should be selected for hydrogen flow tests. These tests shall attempt to correlate the air data with the hydrogen data.

A full scale control drum assembly should investigate the effect of (1) crowned drive shaft splines, (2) spring in the spring pocket, and (3) bearing housings on flow distribution.

CONTROL DRUM-DRIVE SHAFT LOSS COEFFICIENT RIG J66

STATIC PRESSURE PROBES

STATION LOCATION

1.	Nozzle end bearing shaft inlet	1.1	1.2		
2.	Nozzle end				
	a) Small variable	2.1	2.2		
	b) Bearing shaft discharge	2.3	2.4		
3.	Control drum outer ring - nozzle end	3.1	3.2		
4.	Large plenum at control drum inner ring inlet	4.1	4.2	4.3	4.4
5.	Control drum inner ring - nozzle end	5.1	5.2		
6.	Control drum inner ring - dome end	6.1	6.2		
7.	Outer ring & inner ring converging passage - dome end	7.1	7.2		
8.	Control drum outer ring - dome end	8.1	8.2		
9.	Control drum outer ring discharge - dome end	9.1	9.2		
10.	Dome end bearing shaft discharge	10.1	10.2		
11.	Dome end bearing shaft coupling plenum	11.1	11.2		
12.	Drive shaft discharge holes - upstream	12.1	12.2		
13.	Drive shaft discharge - downstream	13.1	13.2		
14.	Actuator end shaft coupling plenum	14.1	14.2		
15.	Drive shaft discharge plenum	15.1	15.2		
16.	Drive shaft discharge plenum	16.1	16.2		
17.	Rig discharge plenum	17.1	17.2		
18.	Nozzle end bearing shaft wall	18.1	18.2		
19.	Drive shaft wall-actuator end	19.1	19.2		

TOTAL PRESSURE PROBES

20.	Nozzle end bearing shaft	20.1	20.2	20.3	20.4
21.	Control drum spring pocket	21.1	21.2	21.3	21.4
22.	Control drum spring pocket	22.1	22.2	22.3	22.4
23.	Dome end of drive shaft	23.1	23.2	23.3	23.4
24.	Actuator end of drive shaft	24.1	24.2	24.3	24.4

Figure 1A - Pressure Probe Identification for Control Drum-Drive Shaft Model

FIGURE 2

CONTROL DRUM-DRIVE SHAFT LOSS COEFFICIENT RIG

FIGURE 3

AFT VIEW OF THE CONTROL DRUM-DRIVE SHAFT LOSS COEFFICIENT RIG

FIGURE 4

TYPICAL "MYLAR" GASKET FLANGE DESIGN

FIGURE 5
FLOW LOOP

FIGURE 6

CONTROL DRUM - DRIVE SHAFT TEST SET-UP

FIGURE 7

CONTROL DRUM DOME END DISCHARGE

FIGURE 8

NOZZLE END BEARING SHAFT PROFILE PROBES (FRONT VIEW)

FIGURE 8 A

NOZZLE END BEARING SHAFT-AFT END VIEW PROFILE PROBES

FIGURE 9

CONTROL DRUM SPRING POCKET PROFILE PROBES

FIGURE 10
DRIVE SHAFT (INSTRUMENTED)

FIGURE 11
DRIVE SHAFT - DOME END
PROFILE PROBES

FIGURE 12

NOZZLE END BEARING SHAFT CENTRAL HOLE FLOW SPLIT

Model Inlet Pressure = 120 PSIG.
 Temperature is Ambient.

FIGURE 13- NOZZLE END BEARING SHAFT PROFILE PROBES - CORRECTION FACTOR
 VS DYNAMIC HEAD - INCHES OF MERCURY

Plugged Calibration Tests.
 Model Inlet Pressure = 120 PSIG.
 Ambient Temperature.

8 Outer Holes of Nozzle End Bearing Shaft and
 Control Drum Outer (8) Holes Are Sealed.

FIGURE 14- NOZZLE END BEARING SHAFT LOSS COEFFICIENT - LOSS COEFFICIENTS
 FOR STATIONS 1.1 TO 2.3 VS REYNOLDS NUMBER

Plugged Calibration Tests.
Model Inlet Pressure = 120 PSIG.
Ambient Temperature.

8 Outer Holes of Nozzle End Bearing Shaft and
Control Drum Outer (8) Holes are Sealed.

FIGURE 15- CONTROL DRUM SPRING POCKET CLOVERLEAF (4.1 TO 5.1)
LOSS COEFFICIENT VS REYNOLDS NUMBER

Model Inlet Pressure = 120 PSIG.
 Ambient Temperature Air.
 Control Drum Outer Tubes Sealed.

FIGURE 16- LOSS COEFFICIENT VS REYNOLDS NUMBER FOR CONTROL DRUM
 INNER TUBES FROM STATIONS 5.1 TO 6.1

FIGURE 17 - DOME END PROFILE PROBES DRIVE SHAFT NO. 2 -
CORRECTION FACTOR VS HEAD - INCHES OF MERCURY

FIGURE 18- LOSS COEFFICIENT (12.1 TO 15.1) VS REYNOLDS NUMBER

FIGURE 19 - CORRECTION FACTOR VS HEAD - INCHES OF WATER

FIGURE 19A- LOSS PARAMETER FOR ACTUATOR END OF DRIVE SHAFT NO. 2
STATION 19.1 TO 16.1 VERSUS MASS FLOW RATE

N_{Re} Based On Central Hole Flow.
 Fluid is Air.
 Temperature is Ambient.
 Model Inlet Pressure = 120 PSIG.

FIGURE 20- PERCENT OF TOTAL FLOW VS REYNOLDS NUMBER FOR THE FOUR NOZZLE END BEARING SHAFTS

N_{Re} Based On Central Hole Flow.
 Fluid is Air.
 Temperature is Ambient.
 Model Inlet Pressure = 120 PSIG.

FIGURE 21- PERCENT OF TOTAL FLOW VS REYNOLDS NUMBER USING THE FOUR NOZZLE END BEARING SHAFTS

N_{Re} Based on Central Hole Flow.
 Fluid is Air.
 Temperature is Ambient.
 Model Inlet Pressure = 120 PSIG.

FIGURE 22 - PERCENT OF TOTAL FLOW VS REYNOLDS NUMBER USING THE FOUR NOZZLE END BEARING SHAFTS

FIGURE 23 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR NOZZLE
 END BEARING SHAFT CENTRAL HOLE FROM LOCATION
 1.1 TO 2.3

FIGURE 24 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR NOZZLE END BEARING SHAFT OUTER (8) HOLES FROM LOCATION 1.1 TO 2.1

FIGURE 25 - LOSS COEFFICIENT VS REYNOLDS NUMBER
 FOR LOCATION 1.1 TO 3.1

FIGURE 26 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR NOZZLE END BEARING SHAFT RING (2.3 - 3.1)

FIGURE 27 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR NOZZLE END BEARING SHAFT RING (2.4 - 2.2)

FIGURE 28 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR CONTROL DRUM INNER (4) TUBES FROM LOCATIONS 4.1 TO 7.1 AND 5.1 TO 7.1

FIGURE 29 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR CONTROL DRUM OUTER (8) TUBES FROM LOCATIONS 2.1 TO 9.1 AND 3.1 TO 9.1

FIGURE 30 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR CONTROL DRUM OUTER (8) TUBES FROM LOCATIONS 2.1 TO 3.1

FIGURE 31 - PERCENT OF TOTAL FLOW VS REYNOLDS NUMBER AT 10.1

FIGURE 32 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR DRIVE SHAFT DISCHARGE HOLES FROM LOCATION 12.1 TO 15.1

FIGURE 33 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR DOME END BEARING SHAFT FROM LOCATION 7.1 TO 10.1

FIGURE 34 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR DOME END BEARING SHAFT FROM LOCATION 10.1 TO 12.1

FIGURE 35 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR DOME END
BEARING SHAFT FROM LOCATION 10.1 TO 12.1

FIGURE 36 - LOSS COEFFICIENT VS REYNOLDS NUMBER FOR DOME END BEARING SHAFT FROM LOCATION 7.1 TO 12.1

FIGURE 37 - LOSS PARAMETER VS REYNOLDS NUMBER FOR ACTUATOR
END COUPLING FROM LOCATION 19.1 TO 16.1

FIGURE 38 - LOSS PARAMETER VS REYNOLDS NUMBER FOR DOME END
 COUPLING FROM LOCATION 10.1 TO 15.1

FIGURE 39 - LOSS PARAMETER VS REYNOLDS NUMBER FOR DOME END COUPLING FROM LOCATION 11.1 TO 15.1

APPENDIX A

The basic program structure is as follows:

APPENDIX A (Continued)

Where the alphabetical listing indicates data input, calculations, and data output of a particular section of the model. The model sections for which the letters refer are as follows:

<u>Letter</u>	<u>Model Section</u>
A.	Those sections (dome end bearing shaft) where the loss coefficient calculations depend on the total mass flow
B.	Those sections (nozzle end bearing shaft) where the loss coefficient calculations depend solely on the flow past calibrated profile probes.
C.	Those sections (control drum spring pocket and inner tubes) where the loss coefficient calculations are dependent on the flow through the control drum (4) inner tubes.
D.	Those sections (nozzle end bearing shaft (8) outer holes) where the loss coefficient calculations depend on the difference between the total mass flow and the flow past the profile probes.
E.	That section (control drum (8) outer tubes) where the loss coefficient calculations depend on the difference between the total mass flow and the flow through the control drum inner tubes.
F.	That section (nozzle end ring) where the loss coefficient calculations depend on the difference between the flow past the nozzle end bearing shaft profile probes and the flow through the control drum (4) inner tubes.

APPENDIX A (Continued)

- G. That section (drive shaft discharge holes) where the loss coefficient calculations depend on the difference between the flow past the actuator end drive shaft profile probes and the dome end drive shaft profile probes.
- H. That section (actuator end splines of drive shaft) where the loss parameter calculations depend on the flow past the actuator end drive shaft profile probes.
- I. That section (dome end bearing shaft central hole) where the loss coefficient calculations depend on the flow through the dome end shaft.
- J. That section (dome end splines of drive shaft) where the loss parameter calculations depend on the difference between the total mass flow and the flow past the dome end drive shaft profile probes.

APPENDIX B

For the purpose of this report, the experimental calibration program begins with test model build No. 3. A brief description of the calibration experiments is as follows:

Description of Calibration Experiments

Build No. 3 -- 6 tests

Conditions: 120 and 90 psig, air at ambient temperature.

Geometry: Drive shaft No. 2 - dome end and actuator end splines are sealed.

Nozzle end bearing shaft No. 1 - 8 outer holes of the nozzle end bearing shaft and control drum are sealed.

Purpose: Calibration of dome end profile probes of drive shaft No. 2 (12.1-23.1, 23.2, 23.3, 23.4);

Calibration of nozzle end bearing shaft No. 1 profile probes, (18.1-20.1, 2-.2, 2-.3, 2-.4);

Calibration of spring pocket control drum flow (4.1-5.1).

Loss coefficients for drive shaft discharge holes (12.1-15.1), nozzle end bearing shaft hole (1.1-2.3), and spring pocket cloverleaf (4.1-5.1).

Build No. 4, 5, 6, and 7 -- 16 tests

Conditions: 120 and 90 psig; air at ambient temperature.

Geometry: Drive shaft No. 2 - dome end and actuator end splines are sealed.

APPENDIX B (Continued)

Purpose: Calibration of nozzle end bearing shaft No. 2, 3, 4, 5.
Profile probes (18.1-20.1, 2-.2, 2-.3, 20.4).
Calibration of spring pocket control drum flow (4.1-5.1).
Loss coefficient for the nozzle end bearing shaft hole
(1.1-2.3) and the spring pocket cloverleaf (4.1-5.1).

Build No. 8 -- 8 tests

Conditions: 120, 100, 90, 80, 60, 40, 30, 20 psig; air at ambient
temperature.

Geometry: Drive shaft No. 2 - dome end splines and discharge
holes are sealed.

Nozzle end bearing shaft No. 5.

Purpose: Calibration of actuator end profile probes.
Loss parameter for actuator end drive shaft splines.

Build No. 9, 10, 11, 12, 13 -- 5 tests

Conditions: 120 psig; air at ambient temperature.

Geometry: Drive shaft No. 2
No. 5, 4, 3, 2, and 1 nozzle end bearing shafts
respectively.

Purpose: Control drum inner tube calibration (5.1-6.1).

APPENDIX C

ESTIMATE OF THE WORST POSSIBLE ERROR

<u>Parameter</u>	<u>Instrument</u>	<u>Range</u>	<u>Graduation</u>	<u>Accuracy (Full Scale)</u>	<u>Possible Error</u>
Pressure	Gauge	0 - 160 psig	2 psi	+ 0.5%	0.8 psi
Pressure	Manometer (Hg)	0 - 50 inch	0.1" Hg	+ 0.08%	0.04" Hg
Pressure	Manometer (H ₂ O)	0 - 50 inch	0.1 H ₂ O	+ 0.08%	0.04" H ₂ O
Pressure	Barometer	0 - 35 inch	0.001" Hg	+ 0.003%	0.001" Hg
Temperature	Thermocouple	0 - +5.5 mv	0.01 mv	+ 0.2%	0.001 mv

Results of calculations of the worst possible error in the loss coefficients for low and high Reynolds numbers is as follows:

<u>Loss Coefficient</u>	<u>Low Reynolds Numbers</u>	<u>High Reynolds Numbers</u>
1.1 - 2.3	+ 55%	+ 14%
1.1 - 2.1	+ 49%	+ 18%
1.1 - 3.1	+ 34%	+ 19%
2.3 - 3-1	+ 99%	+ 21%
2.4 - 2.2	+ 99%	+ 35%
4 - 5	+ 32%	+ 10%
4 - 7	+ 29%	+ 10%
5 - 7	+ 30%	+ 10%
2 - 9	+ 35%	+ 15%
3 - 9	+ 36%	+ 15%
2.1 - 3.1	+ 46%	+ 15%
7 - 10	+ 8%	+ 6%
10 - 12	+ 26%	+ 19%
10 - 15	+ 38%	+ 19%
11 - 15	+ 42%	+ 19%
12 - 15	+ 44%	+ 30%
19 - 16	+ 22%	+ 12%

APPENDIX D

Definition of Headers

A	Area used for loss coefficient calculation (in^2)
ACO	Area used for loss coefficient calculation (in^2)
BACH	Mach number (dimensionless)
CD	FORTTRAN dimensioned flow coefficient variable
CFAC	Flow coefficient for control drum spring pocket
CLDASQ	Loss coefficient divided by the area squared
CNER	Nozzle end ring clearance (inches)
COEFPL	Loss Coefficient
CORMV	Corrected mean velocity (ft/sec)
CORR	Correction factor used for the velocity profile probes
DDIM	Dimension used for Reynolds number calculation (inches)
DDIMPT	Diameter at profile probe plane location (inches)
DELMAN	Pressure difference between upstream and downstream of ASME nozzle (inches of water, inches of mercury)
DELP	Pressure drop between loss coefficient station locations (inches of mercury)
DELP 56	Pressure drop between station locations 5 and 6 (inches of mercury)
DELPON	DELMAN converted to inches of water
DELPUP	ASME nozzle upstream pressure (inches of mercury)
DELPXY	Pressure difference between any two station locations

APPENDIX D (Continued)

DIM	Dimension used for Reynolds Number calculation (inches)
DNEP	Nozzle end plenum depth (inches)
FLØW	The mass flow in the model zone of interest (lb _m /sec)
H1	Code for DELMAN. Plus if mercury, minus if water
H2	Code for HEAD. Plus if mercury, minus if water
HEAD	Average velocity head (inches of mercury, inches of water)
HEAD 1,2,3,4	Profile probe velocity head (inches of mercury)
IBN	Test model build number
IDSN	Drive shaft designation
INEBSN	Nozzle end bearing shaft designation
LAYOUT	Describes format desired for print out
MACH	Mach Number (dimensionless)
NCASE	Number of data points per build
PI	Model inlet pressure
PBARHG	Barometric pressure (inches of mercury)
PDOWN	Pressure downstream of ASME nozzle (inches of mercury)
PGPIT	Static pressure in profile probe plane (psig)
PRCTW	Percent of the total flow through a particular zone of the model
PS51	Pressure at the 5.1 station location (psig)
PSIBAR	Barometric pressure (psia)
PXA	Pressure at the upstream loss coefficient location (psia)
PXG	Pressure at the upstream loss coefficient location (psig)
REYN	Reynolds Number (dimensionless)

APPENDIX D (Continued)

RHO51	Density at the 5.1 station location (lb_m/ft^3)
RHOC	Density used in the loss coefficient calculation (lb_m/ft^3)
RHOPI	Density in the profile probe plane (lb_m/ft^3)
RHOW	Density at the upstream ASME nozzle location (lb_m/ft^3)
SDSDH	Drive shaft discharge hole size (inch)
T	Average temperature (degrees Rankine)
T1	Inlet temperature (degrees Fahrenheit)
T2	Outlet temperature (degrees Fahrenheit)
VELM	Average velocity (ft/sec)
VISC	Viscosity of the air computed for the average temperature ($\text{lb}_m/\text{ft sec}$)
W1, W2, W3	Refer to schematic and alphabetic description of the schematic on the preceding pages of Appendix A.
W4, W5	
WFLOW	The mass flow rate in the model zone of interest (lb_m/sec)
WNOZ	Flow through the ASME nozzle. Takes into account velocity of approach and compressibility factors. (lb_m/sec)
WPITOT	Flow past the profile probes (lb_m/sec)
WTUBES	Flow through the inner four control drum tubes (lb_m/sec)
X	Average temperature (degrees Fahrenheit)


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      DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

      DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)
100  READ INPUT TAPE 5,1, IBN,IDSN,INEBSN,LAYOUT,NCASE
    99  READ INPUT TAPE 5,2,SDSDH,CNER,DNEP,A,DIM
    981 READ INPUT TAPE 5,2,W1,W2,W3,W4,W5
    98  READ INPUT TAPE 5,3, (ITITLE(I),I=1,12)
C      JNOTES IS USED TO IDENTIFY LOSS COEF STATIONS. TWO CARDS MUST BE
C      USED REGARDLESS IF THEY ARE BLANK OR FILLED. REFER FORMAT 3.
    982 READ INPUT TAPE 5, 3, JNOTES
      INCASE=0
    50  WRITE OUTPUT TAPE 6,4, IBN,(ITITLE(I),I=1,3),INEBSN,CNER,DNEP,
    1   IDSN,SDSDH,(ITITLE(I),I=4,11)
    501 WRITE OUTPUT TAPE 6,10, JNOTES
      IF (LAYOUT) 49,49,48
    49  WRITE OUTPUT TAPE 6,5
      GO TO 97
    48  WRITE OUTPUT TAPE 6,6
C      LAYOUT EQUALS -1 WHEN THE FLOW THRU EITHER OF THE DRIVE SHAFT
C      SPLINES IS TO BE DETERMINED.
C      LAYOUT EQUALS +1 WHEN THE FLOW THRU ANY OTHER PART OF THE TEST
C      FIXTURE IS TO BE DETERMINED.
    97  READ INPUT TAPE 5,7,PBARHG,DELPHG,DELMAN,T1,T2,H1
      T=(T1+T2)/2.+460.
      X=(T1+T2)/2.
      VISC=((0.0016 * X) + 1.1152) * 0.00001
      PSIBAR=PBARHG*0.4912
      DELPUP=DELPHG*0.4912
      PUPNOZ=PSIBAR+DELPUP
      RHOW=2.69966*PUPNOZ/T
      IF (H1) 90,90,89
    90  DELPON=DELMAN
      GO TO 88
    89  DELPON=13.5954*DELMAN
    88  PDOWN = PUPNOZ - ( DELPON * 0.03613)
      WNOZ = 0.18369 * SQRTF((RHOW*DELPON*((PDOWN/PUPNOZ)**1.4286)
    1 * ((1.0 - (PDOWN/PUPNOZ)**0.28571)/(1.0 - (PDOWN/PUPNOZ))))/
    2 (1.0 - 0.24424 * ((PDOWN/PUPNOZ) **1.4286)))
      IF (W1) 87,86,85
    87  WFLOW=WNOZ
    96  READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM
      PXA=PXG+PSIBAR
      DELPXY=DELP*0.4912
      RHOC=2.69966*PXA/T
      COEFPL=0.44722*RHOC*DELPXY*A**2/WFLOW**2
  
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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)	
REYN=12.*WFLOW*DIM/(VISC*A)	045
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))	046
PRCTW=100.	047
INCASE=INCASE + 1	048
46 WRITE OUTPUT TAPE 6,8,INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,	049
1 COEFPL, BACH	050
GO TO 59	051
86 GO TO 84	052
85 READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM,H2,PGPIT,	053
1 DDIMPT,CFAC, HEAD1,HEAD2,HEAD3,HEAD4	054
PSPIT=PGPIT + PSIBAR	055
PXA=PXG + PSIBAR	056
DELPXY = DELP * 0.4912	057
RHUC = 2.69966 * PXA / T	058
RHOPIT=2.69966 * PSPIT / T	059
HEAD= (HEAD1 + HEAD2 + HEAD3 + HEAD4)/4.0	060
CORR(1)=(0.010555 * HEAD) + 1.0753	061
CORR(2)=(0.01675 * HEAD) + 1.0366	062
CORR(3)=(0.009473 * HEAD) + 1.0656	063
CORR(4) = (0.012045 * HEAD) + 1.07	064
IF (H2) 80,80,79	065
80 HEAD=HEAD	066
GO TO 78	067
79 HEAD= (HEAD*13.5954)	068
78 VELM= 18.25 * SQRTF(HEAD/RHOPIT)	069
CORMV = CORR(INEBSN) * VELM	070
AREA = 0.785 * DDIMPT ** 2.	071
WFLOW=CORMV*RHOPIT*AREA/144.	072
IF (W2) 76,76,75	073
76 IF (W5) 761,761,75	074
761 COEFPL= 0.44722*RHOC*DELPXY*ACO**2./WFLOW**2.	075
REYN=12.*WFLOW*DDIM/(VISC*ACO)	076
PRCTW=WFLOW/WNOZ*100.	077
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))	078
INCASE=INCASE + 1	079
47 WRITE OUTPUT TAPE 6,8,INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,	080
1 COEFPL, BACH	081
GO TO 59	082
84 IF (W2) 83,82,81	083
83 READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM,CL,P51,DELP56	084
CD(1) = 0.735	085
CD(2) = 0.759	086
CD(3) = 0.768	087

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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

CD(4) = 0.786
PS51=P51 + PSIBAR
RHO51=2.69966 * PS51/T
WFLOW = 0.1104 * CD(INEBSN) * SQRTF(0.219675 * RHO51 * DELP56)
PXA=PXG+PSIBAR
DELPXY = DELP * 0.4912
RHUC = 2.69966 * PXA / T
IF (W3) 70, 71, 72
71 COEFPL = 0.44722 * RHOC*DELPXY*A**2/WFLOW**2
REYN=12.*WFLOW*DIM/(VISC*A)
PRCTW=WFLOW/WNOZ*100.
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))
INCASE=INCASE + 1
45 WRITE OUTPUT TAPE 6,8, INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
81 GO TO 85
75 WPITOT=WFLOW
WFLOW=WNOZ-WPITOT
COEFPL=0.44722*RHOC*DELPXY*A**2/WFLOW**2
56 REYN=12.*WFLOW*DIM/(VISC*A)
PRCTW=WFLOW/WNOZ*100.
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))
INCASE=INCASE + 1
44 WRITE OUTPUT TAPE 6,8, INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
82 IF (W3) 74,73,72
74 GO TO 83
70 WTUBES=WFLOW
WFLOW=WNOZ-WTUBES
COEFPL=0.44722*RHOC*DELPXY*A**2/WFLOW**2
REYN=12.*WFLOW*DIM/(VISC*A)
PRCTW=WFLOW/WNOZ*100.
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))
INCASE = INCASE + 1
43 WRITE OUTPUT TAPE 6,8, INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
72 READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM,CL,P51,DELP56,
1 PGPIT,CFAC,DDIMPT,HEAD1,HEAD2,HEAD3,HEAD4
PSPIT=PGPIT + PSIBAR
PXA=PXG + PSIBAR
  
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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

DELPXY=DELP * 0.4912
RHOC= 2.69966 * PXA / T
RHOPIT= 2.69966 * PSPIT / T
HEAD=13.5954 * (HEAD1+HEAD2+HEAD3+HEAD4)/4.0
VELM=18.25 * SQRTF (HEAD/RHOPIT)
CORR(1)=(0.010555 * HEAD/13.5954) + 1.0753
CORR(2)=(0.01675 * HEAD/13.5954) + 1.0366
CORR(3)=(0.009473 * HEAD/13.5954) + 1.0656
CORR(4)=(0.012045 * HEAD/13.5954) + 1.07
CORMV = CORR(INEBSN) * VELM
AREA=0.785 * DDIMPT**2.
WCALP1=CORMV * RHOPIT * AREA / 144.
CD(1) = 0.735
CD(2) = 0.759
CD(3) = 0.768
CD(4) = 0.786
PS51=PS1 + PSIBAR
RH051=2.69966 * PS51 / T
WTUBES =0.1104 * CD(INEBSN) * SQRTF(0.219675 * RH051 * DELP56)
WFLOW=WCALP1 -WTUBES
COEFPL =0.44722 * RHOC * DELPXY*A**2/WFLOW**2
REYN = 12.*WFLOW*DIM/(VISC * A)
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))
PRCTW = WFLOW/WNOZ * 100.
INCASE=INCASE + 1
42 WRITE OUTPUT TAPE 6,8,INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
73 IF(W4) 69,68,67
69 READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM,PGPIT1,CORR1,
1 DIMPT1,HEAD11,HEAD12,HEAD13,HEAD14,PGPIT2,CORR2,DIMPT2,HEAD21,
2 HEAD22,HEAD23,HEAD24,H21,H22
PSPIT1=PGPIT1 + PSIBAR
PXA = PXG + PSIBAR
DELPXY=DELP * 0.4912
RHOC = 2.69966 * PXA / T
PSPIT2= PGPIT2 + PSIBAR
ROPIT1= 2.69966 * PSPIT1 / T
ROPIT2= 2.69966 * PSPIT2 / T
HEAD11 = HEAD12
HEAD14 = HEAD13
HEAD1 = (HEAD11 + HEAD12 + HEAD13 + HEAD14)/4.0
CORR1 = (0.006 * HEAD1) + 0.631
  
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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

HEAD2 = (HEAD21 + HEAD22 + HEAD23 + HEAD24)/4.0
CORR2 = (0.019841 * HEAD2) + 0.9865
IF (H21) 66,66,65
66 HEAD1=HEAD1
GO TO 64
65 HEAD1=13.5954 * HEAD1
64 IF (H22) 63,63,62
63 HEAD2=HEAD2
GO TO 61
62 HEAD2=13.5954*HEAD2
61 VELM1=18.25 * SQRTF (HEAD1/ROPIT1)
VELM2=18.25 * SQRTF (HEAD2/ROPIT2)
CORMV1=CORR1 * VELM1
CORMV2=CORR2 * VELM2
AREA1=0.785 * DIMPT1**2.
AREA2=0.785 * DIMPT2**2.
WCALP1=CORMV1 * ROPIT1 * AREA1 / 144.
WCALP2=CORMV2 * ROPIT2 * AREA2 / 144.
WFLOW= WCALP1 - WCALP2
COEFPL = 0.44722 * RHOC * DELPXY * A**2 /WFLOW**2
REYN = 12.* WFLOW * DIM / (VISC * A)
PRCTW = WFLOW / WNOZ * 100.
BACH = 2.9376 * WFLOW/(A*RHOC*SQRTF(T))
INCASE = INCASE + 1
41 WRITE OUTPUT TAPE 6,8, INCASE,P1,PXA,DELPXY,T,WFLOW,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
67 READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,H2,PGPIT,
1 DDIMPT, CFAC, HEAD1,HEAD2,HEAD3,HEAD4
PSPIT=PGPIT + PSIBAR
PXA= PXG + PSIBAR
DELPXY =DELP * 0.4912
RHOC= 2.69966 * PXA / T
RHOPIT=2.69966*PSPIT/T
HEAD=(HEAD1+HEAD2+HEAD3+HEAD4)/4.0
CFAC = (0.019841 * HEAD) + 0.9865
VELM=18.25 * SQRTF(HEAD/RHOPIT)
CORMV=CFAC*VELM
AREA=0.785 * DDIMPT**2.
WFLOW=CORMV*RHOPIT*AREA/144.
CLDASQ = 0.44722 * RHOC * DELPXY/(WFLOW**2)
REYN = 12.* WNOZ * DIM / (VISC * A)
PRCTW= WFLOW/WNOZ*100.
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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

INCASE = INCASE + 1
40 WRITE OUTPUT TAPE 6,9, INCASE,P1,PXA,DELPXY,T,CLDASQ,WFLOW,
1 PRCTW, REYN
GO TO 59
68 IF (W5) 58,59,57
57 ACO = 1.0
READ INPUT TAPE 5,7,X,Y,P1,PXG,DELP,ACO,DDIM,H2,PGPIT,
1 DDIMPT,CFAC,HEAD1,HEAD2,HEAD3,HEAD4
PSPIT = PGPIT + PSIBAR
PXA = PXG + PSIBAR
DELPXY = DELP * 0.4912
RHOC = 2.69966 * PXA / T
RHOPIT = 2.69966 * PSPIT / T
HEAD1 = HEAD2
HEAD4 = HEAD3
HEAD = (HEAD1 + HEAD2 + HEAD3 + HEAD4)/4.0
CFAC = (0.006 * HEAD) + 0.631
IF (H2) 20,20,19
20 HEAD = HEAD
GO TO 18
19 HEAD = (HEAD * 13.5954 )
18 VELM = 18.25 * SQRTF (HEAD/RHOPIT)
CURMV = CFAC * VELM
AREA = 0.785 * DDIMPT **2
WFLOW = CORMV * RHOPIT * AREA/144.
WPITOT = WFLOW
WFLOW = WNOZ -WPITOT
COEFPL = 0.44722 * RHOC * DELPXY * ACO**2/WFLOW**2
CLDASQ = COEFPL
PRCTW = WFLOW/WNOZ * 100.
REYN = 12.*WNOZ * DIM/(VISC * A)
INCASE=INCASE + 1
WRITE OUTPUT TAPE 6,9, INCASE,P1,PXA,DELPXY,T,CLDASQ,WFLOW,
1 PRCTW,REYN
GO TO 59
C FOR LOSS COEFFICIENT FROM 10.1 TO 12.1 BASED ON AREA AND FLOW AT
C 10.1. UTILIZING THE DATA AS ORIGINALLY INPUT THE FOLLOWING INPUT
C STATEMENT HAS TO BE USED.
58 READ INPUT TAPE 5,7, X,Y,P1,PXG,DELP,ACO,DDIM,H2,PGPIT,
1 DDIMPT,CFAC,HEAD1,HEAD2,HEAD3,HEAD4
PSPIT=PGPIT + PSIBAR
PXA = PXG + PSIBAR
DELPXY = DELP * 0.4912
    
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~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act 1954~~

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DIMENSION ITITLE(12),JNOTES(20),CD(4),CORR(4)

RHOC = 2.69966 * PXA / T
COEFPL = 0.44722 * RHOC * DELPHY * A **2/WNOZ**2
REYN = 12.*WNOZ * DIM/(VISC * A)
BACH = 2.9376 * WNOZ /(A*RHOC*SQRTF(T))
PRCTW = 100.
INCASE =INCASE + 1
WRITE OUTPUT TAPE 6,8,INCASE,PI,PXA,DELPXY,T,WNOZ,PRCTW,REYN,
1 COEFPL, BACH
GO TO 59
59 IF (INCASE - NCASE) 97,100,100
1 FORMAT (5I12)
2 FORMAT (6E12.4)
3 FORMAT (12A6)
4 FORMAT (1H1,6X,50HD4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIEN
1TS // 7X,12HBUILD NUMBER,11X,I6,20X,24HNOZZLE END BEARING SHAFT/
2 7X,8HRUN DATE,6X,3A6, 21X,7H-NUMBER,27X,I6/ 60X, 22H-RING CL
3EARANCE (INCH),6X,F12.4/7X,11HDRIVE SHAFT,42X, 20H-PLENUM DEPTH
4(INCH), 8X, F12.4/10X, 7H-NUMBER,16X,I6/10X,27H-DISCHARGE HOLE SIZ
5E (INCH),1X,F6.4,12X, 8HFLUID IS, 1X, 8A6)
5 FORMAT (1H0,13X,2HP1,10X,3HPXA,8X,6HDELPXY,5X,4HTEMP,5X,6HCLDASQ,
1 8X,4HFLOW,7X,5HPRCTW,7X,4HREYN/13X,4HPSIG,9X,4HPSIA,8X,4HPSID,
3 6X,5HDEG R,4X,6HINCH-4,7X,6HLB/SEC,17X,6H(10.1)/)
6 FORMAT (1H0,11X,2HP1,6X,3HPXA,5X,6HDELPXY,5X,4HTEMP,5X,4HFLOW,
1 6X,5HPRCTW,5X,4HREYN,7X,6HCOEFPL,6X,4HMACH/11X,4HPSIG,5X,4HPSIA,
2 5X,4HPSID,6X,5HDEG R,3X,6HLB/SEC//)
7 FORMAT (6E12.4)
8 FORMAT (7X,I2,2X,F6.2,2X,F6.2,1X,E11.4,2X,F5.1,1X,E10.3,2X,F6.2,
1 1X,E11.4,1X,E11.4,1X,E10.3)
9 FORMAT (5X,I2,2X,E11.4,2X,E11.4,2X,E11.4,2X,F5.1,2X,E11.4,2X,
1 E11.4,2X,F6.2,3X,E11.4)
10 FORMAT (20A6)
END
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Astronuclear
WANT-TME-715

~~CONFIDENTIAL~~
~~RESTRICTED DATA~~
~~Atomic Energy Act 1954~~

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
 RUN DATE NOVEMBER 6, 1963

NOZZLE END BEARING SHAFT

-NUMBER 1
 -RING CLEARANCE (INCH) 0.0064
 -PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT CENTRAL HOLE (1.1 TO 2.3). AREA BASED ON 0.5312 DIA.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLCW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	136.79	0.1032E-00	533.5	0.433E-01	50.86	0.1010E 06	0.8370E 00	0.359E-01
2	119.75	134.04	0.1572E-00	533.5	0.470E-01	49.52	0.1097E 06	0.1059E 01	0.398E-01
3	121.20	135.49	0.1130E-00	533.5	0.537E-01	51.76	0.1253E 06	0.5899E 00	0.450E-01
4	121.20	135.49	0.7308E-01	534.5	0.541E-01	48.48	0.1262E 06	0.3776E-00	0.454E-01
5	121.00	135.29	0.1081E-00	534.5	0.583E-01	48.95	0.1358E 06	0.4773E-00	0.489E-01
6	119.50	133.79	0.1081E-00	534.5	0.634E-01	50.31	0.1477E 06	0.3992E-00	0.538E-01
7	122.30	136.59	0.1857E-00	534.5	0.690E-01	52.11	0.1609E 06	0.5935E 00	0.574E-01
8	120.50	134.79	0.2260E-00	534.5	0.727E-01	52.50	0.1695E 06	0.6382E 00	0.613E-01
9	119.00	133.30	0.2358E-00	533.5	0.744E-01	51.47	0.1737E 06	0.6301E 00	0.633E-01
10	120.75	135.05	0.2849E-00	534.5	0.781E-01	52.15	0.1822E 06	0.6982E 00	0.657E-01
11	122.00	136.30	0.3193E-00	534.5	0.806E-01	51.92	0.1879E 06	0.7428E 00	0.671E-01
12	120.00	134.30	0.3537E-00	534.5	0.831E-01	51.83	0.1937E 06	0.7627E 00	0.703E-01
13	120.20	134.50	0.3434E-00	534.5	0.872E-01	52.79	0.2033E 06	0.6742E 00	0.736E-01
14	121.60	135.90	0.2808E-00	534.5	0.891E-01	52.43	0.2077E 06	0.5501E 00	0.744E-01
15	120.50	134.80	0.3930E-00	534.5	0.920E-01	52.78	0.2144E 06	0.6941E 00	0.775E-01
16	121.00	135.30	0.4470E-00	534.5	0.936E-01	52.38	0.2182E 06	0.7648E 00	0.786E-01
17	119.75	134.22	0.4912E-00	535.0	0.959E-01	52.14	0.2235E 06	0.7935E 00	0.812E-01
18	119.00	133.47	0.5403E 00	532.5	0.100E-00	53.13	0.2342E 06	0.7993E 00	0.851E-01
19	120.50	134.97	0.5452E 00	532.0	0.102E-00	53.15	0.2394E 06	0.7819E 00	0.859E-01
20	121.00	135.47	0.5796E 00	531.0	0.104E-00	52.83	0.2433E 06	0.8115E 00	0.868E-01
21	120.10	134.57	0.5944E 00	530.0	0.105E-00	52.46	0.2466E 06	0.8081E 00	0.884E-01
22	120.00	134.47	0.6396E 00	526.5	0.108E-00	52.79	0.2548E 06	0.8256E 00	0.907E-01
23	119.00	133.46	0.6336E 00	527.0	0.113E-00	53.30	0.2668E 06	0.7460E 00	0.958E-01
24	119.50	133.96	0.7308E 00	526.5	0.120E-00	53.43	0.2819E 06	0.7756E 00	0.101E-00
25	120.00	134.44	0.8252E 00	533.0	0.123E-00	53.12	0.2885E 06	0.8084E 00	0.104E-00
26	120.20	134.64	0.8743E 00	532.5	0.130E-00	53.44	0.3029E 06	0.7800E 00	0.109E-00
27	120.00	134.44	0.9578E 00	532.5	0.134E-00	53.32	0.3131E 06	0.7985E 00	0.113E-00
28	119.80	134.24	0.1007E 01	531.5	0.139E-00	53.59	0.3257E 06	0.7780E 00	0.117E-00
29	119.50	133.94	0.1040E 01	531.5	0.144E-00	53.85	0.3372E 06	0.7840E 00	0.122E-00
30	120.30	134.74	0.1130E 01	531.5	0.148E-00	53.67	0.3459E 06	0.7766E 00	0.124E-00
31	120.50	134.94	0.1277E 01	531.0	0.160E-00	54.19	0.3751E 06	0.7493E 00	0.134E-00
32	120.50	134.94	0.1474E 01	531.5	0.166E-00	54.18	0.3897E 06	0.7996E 00	0.140E-00
33	120.50	134.91	0.1523E 01	531.5	0.172E-00	54.31	0.4028E 06	0.7730E 00	0.144E-00
34	120.30	134.71	0.1719E 01	532.0	0.179E-00	54.72	0.4186E 06	0.8051E 00	0.151E-00
35	119.85	134.26	0.1817E 01	532.0	0.184E-00	54.86	0.4307E 06	0.8013E 00	0.155E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT

-NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PL-NUM DEPTH (INCH) 0.1748

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT CENTRAL HOLE (1.1 TO 2.3). AREA BASED ON 0.5312 DIA.

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.86	0.1572E-00	533.0	0.500E-01	58.53	0.1167E 03	0.9441E 00	0.420E-01
2	120.75	135.11	0.1965E-00	531.5	0.553E-01	58.09	0.1295E 06	0.9659E 00	0.464E-01
3	120.50	134.87	0.2309E-00	531.5	0.601E-01	57.73	0.1408E 06	0.9594E 00	0.505E-01
4	120.20	134.57	0.2800E-00	531.5	0.658E-01	58.62	0.1540E 06	0.9700E 00	0.554E-01
5	121.20	135.57	0.2947E-00	531.5	0.707E-01	59.11	0.1655E 03	0.8902E 00	0.591E-01
6	121.00	135.37	0.3438E-00	531.5	0.728E-01	57.53	0.1705E 06	0.9777E 00	0.609E-01
7	120.75	135.12	0.3635E-00	533.0	0.770E-01	57.94	0.1799E 06	0.9198E 00	0.647E-01
8	121.75	136.11	0.3831E-00	533.0	0.804E-01	57.85	0.1879E 06	0.8959E 00	0.670E-01
9	120.80	135.16	0.3733E-00	533.0	0.810E-01	55.96	0.1893E 06	0.8541E 00	0.680E-01
10	120.75	135.07	0.4421E-00	535.0	0.879E-01	58.60	0.2048E 06	0.8557E 00	0.739E-01
11	120.50	134.82	0.4814E-00	536.5	0.895E-01	57.74	0.2081E 06	0.8947E 00	0.755E-01
12	120.20	134.52	0.4814E-00	536.5	0.926E-01	57.84	0.2154E 06	0.8331E 00	0.784E-01
13	121.50	135.82	0.4814E-00	536.5	0.933E-01	56.60	0.2171E 03	0.8284E 00	0.782E-01
14	120.60	134.92	0.3684E-00	536.0	0.993E-01	58.48	0.2310E 06	0.5573E 00	0.837E-01
15	121.00	135.32	0.3831E-00	536.0	0.978E-01	56.13	0.2276E 06	0.5990E 00	0.822E-01
16	121.00	135.32	0.3930E-00	537.5	0.865E-01	48.51	0.2008E 06	0.7840E 00	0.728E-01
17	120.75	135.04	0.4917E-00	533.0	0.110E-00	58.83	0.2571E 06	0.6084E 00	0.924E-01
18	121.30	135.59	0.6386E 00	531.5	0.114E-00	58.63	0.2678E 06	0.7372E 00	0.956E-01
19	120.60	134.89	0.7122E 00	531.0	0.121E-00	59.91	0.2844E 06	0.7270E 00	0.102E-00
20	120.60	134.89	0.6631E 00	531.0	0.126E-00	59.39	0.2943E 06	0.6317E 00	0.105E-00
21	119.85	134.14	0.9677E 00	531.0	0.140E-00	60.51	0.3284E 06	0.7366E 00	0.118E-00
22	120.75	135.04	0.1204E 01	531.0	0.172E-00	61.21	0.4030E 06	0.6123E 00	0.144E-00
23	120.00	134.29	0.1474E 01	530.0	0.187E-00	61.11	0.4386E 06	0.6323E 00	0.158E-00
24	120.00	134.29	0.1596E 01	530.5	0.204E-00	62.18	0.4773E 06	0.5771E 00	0.172E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT

-NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT CENTRAL HOLE (1.1 TO 2.3). AREA BASED ON 0.5312 DIA.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	133.72	0.1474E-00	535.5	0.498E-01	58.43	0.1160E 06	0.8788E 00	0.423E-01
2	118.00	132.21	0.5894E-01	537.5	0.562E-01	59.69	0.1306E 06	0.2715E-00	0.484E-01
3	120.50	134.71	0.1572E-00	538.0	0.604E-01	58.67	0.1402E 06	0.6392E 00	0.511E-01
4	120.50	134.71	0.1916E-00	538.0	0.672E-01	60.62	0.1560E 06	0.6290E 00	0.569E-01
5	121.50	135.71	0.1965E-00	537.0	0.709E-01	59.86	0.1647E 06	0.5858E 00	0.594E-01
6	121.30	135.51	0.2309E-00	538.0	0.741E-01	59.19	0.1719E 06	0.6275E 00	0.623E-01
7	120.60	134.81	0.2309E-00	536.5	0.801E-01	60.78	0.1862E 06	0.5359E 00	0.676E-01
8	121.90	136.12	0.3193E-00	537.5	0.830E-01	60.26	0.1928E 06	0.6950E 00	0.695E-01
9	120.30	134.52	0.3045E-00	537.5	0.685E-01	47.71	0.1591E 06	0.9617E 00	0.580E-01
10	120.50	134.72	0.3438E-00	536.0	0.791E-01	53.04	0.1842E 06	0.8172E 00	0.668E-01
11	121.10	135.35	0.4912E-00	536.0	0.851E-01	59.11	0.1979E 06	0.1015E 01	0.715E-01
12	121.00	135.25	0.5354E 00	536.0	0.838E-01	56.10	0.1949E 06	0.1140E 01	0.705E-01
13	120.75	135.00	0.5354E 00	536.0	0.922E-01	59.59	0.2145E 06	0.9403E 00	0.776E-01
14	120.00	134.26	0.3831E-00	535.5	0.950E-01	59.42	0.2212E 06	0.6305E 00	0.804E-01
15	120.70	134.96	0.4421E-00	535.5	0.997E-01	60.48	0.2320E 06	0.6646E 00	0.839E-01
16	121.20	135.46	0.2456E-00	535.5	0.100E-00	59.28	0.2338E 06	0.3650E-00	0.843E-01
17	120.00	134.36	0.5256E 00	526.0	0.929E-01	52.77	0.2191E 06	0.9205E 00	0.779E-01
18	120.50	134.86	0.4421E-00	524.0	0.105E-00	57.88	0.2473E 06	0.6155E 00	0.873E-01
19	120.75	135.10	0.6631E 00	524.0	0.115E-00	60.86	0.2721E 06	0.7642E 00	0.958E-01
20	120.75	135.10	0.7368E 00	524.5	0.119E-00	60.39	0.2807E 06	0.7959E 00	0.990E-01
21	120.00	134.35	0.7368E 00	524.5	0.125E-00	61.13	0.2951E 06	0.7163E 00	0.105E-00
22	121.20	135.55	0.8154E 00	523.0	0.130E-00	61.15	0.3074E 06	0.7418E 00	0.108E-00
23	119.50	133.85	0.1090E 01	522.5	0.158E-00	62.29	0.3738E 06	0.6643E 00	0.132E-00
24	120.10	134.44	0.1621E 01	526.0	0.177E-00	62.76	0.4178E 06	0.7814E 00	0.149E-00
25	119.90	134.24	0.1867E 01	525.0	0.194E-00	63.29	0.4591E 06	0.7475E 00	0.163E-00
26	120.60	134.94	0.2186E 01	525.0	0.209E-00	63.80	0.4943E 06	0.7589E 00	0.175E-00
27	120.00	134.34	0.1595E 01	525.0	0.187E-00	63.17	0.4405E 06	0.6947E 00	0.156E-00
28	120.00	134.34	0.1989E 01	524.0	0.201E-00	63.16	0.4758E 06	0.7455E 00	0.169E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT CENTRAL HOLE (1.1 TO 2.3). AREA BASED ON 0.5312 DIA.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLCW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.82	0.8842E-01	528.5	0.502E-01	58.66	0.1180E 06	0.5298E 00	0.421E-01
2	121.00	135.31	0.9824E-01	531.5	0.551E-01	57.94	0.1290E 06	0.4875E-00	0.461E-01
3	120.30	134.61	0.1081E-00	528.0	0.594E-01	56.91	0.1396E 06	0.4630E-00	0.498E-01
4	120.30	134.61	0.1130E-00	527.0	0.616E-01	54.45	0.1451E 06	0.4498E-00	0.516E-01
5	121.50	135.81	0.1719E-00	527.0	0.668E-01	55.65	0.1572E 06	0.5888E 00	0.554E-01
6	121.20	135.51	0.1905E-00	527.0	0.715E-01	56.35	0.1684E 06	0.5848E 00	0.595E-01
7	121.00	135.31	0.2112E-00	527.0	0.745E-01	55.82	0.1753E 06	0.5791E 00	0.621E-01
8	121.30	135.61	0.2456E-00	527.0	0.786E-01	56.32	0.1851E 06	0.6058E 00	0.654E-01
9	120.30	134.64	0.3438E-00	531.5	0.815E-01	56.24	0.1909E 06	0.7759E 00	0.686E-01
10	121.00	135.34	0.3684E-00	529.5	0.839E-01	55.65	0.1969E 06	0.7920E 00	0.701E-01
11	120.60	134.94	0.3831E-00	528.5	0.872E-01	55.83	0.2050E 06	0.7613E 00	0.730E-01
12	121.00	135.35	0.3930E-00	527.5	0.913E-01	56.54	0.2149E 06	0.7159E 00	0.761E-01
13	121.00	135.35	0.4323E-00	527.0	0.933E-01	56.04	0.2197E 06	0.7552E 00	0.778E-01
14	121.10	135.45	0.4705E-00	527.0	0.964E-01	56.28	0.2270E 06	0.7805E 00	0.803E-01
15	121.50	135.85	0.4912E-00	526.0	0.989E-01	56.23	0.2333E 06	0.7675E 00	0.821E-01
16	121.50	135.85	0.5059E 00	526.0	0.102E-00	56.73	0.2412E 06	0.7394E 00	0.849E-01
17	120.00	134.36	0.5894E 00	528.0	0.106E-00	56.47	0.2502E 06	0.7847E 00	0.894E-01
18	120.50	134.85	0.6386E 00	527.5	0.111E-00	56.48	0.2611E 06	0.7849E 00	0.929E-01
19	120.10	134.46	0.6877E 00	527.5	0.116E-00	57.12	0.2740E 06	0.7655E 00	0.977E-01
20	121.10	135.53	0.7663E 00	525.5	0.120E-00	56.67	0.2839E 06	0.8084E 00	1.000E-01
21	121.50	135.93	0.1130E 01	524.5	0.146E-00	57.84	0.3453E 06	0.8116E 00	0.121E-00
22	121.00	135.43	0.1449E 01	524.5	0.167E-00	59.72	0.3936E 06	0.7981E 00	0.138E-00
23	120.75	135.18	0.1734E 01	523.5	0.183E-00	59.24	0.4327E 06	0.7925E 00	0.152E-00
24	120.50	134.93	0.1965E 01	523.5	0.196E-00	59.33	0.4629E 06	0.7830E 00	0.163E-00
25	120.70	135.13	0.1572E 01	524.0	0.175E-00	58.84	0.4127E 06	0.7875E 00	0.145E-00
26	120.00	134.43	0.1876E 01	524.0	0.190E-00	59.55	0.4496E 06	0.7860E 00	0.159E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
 RUN DATE NOVEMBER 6, 1963

NOZZLE END BEARING SHAFT

-NUMBER 1
 -RING CLEARANCE (INCH) 0.0064
 -PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT OUTER (8) HOLES (1.1 TO 2.1). AREA FOR 8-0.185 DIA

	P1 PSIG	PXA PSIA	DPLPX PSIG	TEMP DFG R	FLGW LB/SFC	PRCTW	REYN	COEFPL	MACH
1	122.50	136.79	0.1965E-00	533.5	0.418E-01	49.14	0.3502E 05	0.1608E 01	0.357E-01
2	117.75	134.04	0.2456E-00	533.5	0.479E-01	50.48	0.4013E 05	0.1500E 01	0.418E-01
3	121.20	135.49	0.2210E-00	533.5	0.500E-01	48.24	0.4192E 05	0.1251E 01	0.432E-01
4	121.20	135.49	0.1817E-00	534.5	0.575E-01	51.52	0.4812E 05	0.7769E 00	0.497E-01
5	121.00	135.29	0.2849E-00	534.5	0.608E-01	51.05	0.5085E 05	0.1089E 01	0.526E-01
6	119.50	133.79	0.2849E-00	534.5	0.626E-01	49.69	0.5236E 05	0.1016E 01	0.547E-01
7	122.30	136.59	0.3831E-00	534.5	0.634E-01	47.89	0.5306E 05	0.1358E 01	0.543E-01
8	120.50	134.79	0.4666E-00	534.5	0.658E-01	47.50	0.5505E 05	0.1516E 01	0.571E-01
9	119.00	133.30	0.5010E 00	533.5	0.702E-01	48.53	0.5879E 05	0.1418E 01	0.616E-01
10	120.75	135.05	0.5256E 00	534.5	0.717E-01	47.85	0.6000E 05	0.1440E 01	0.621E-01
11	122.00	136.30	0.5944E 00	534.5	0.746E-01	48.08	0.6244E 05	0.1518E 01	0.641E-01
12	120.00	134.30	0.6386E 00	534.5	0.772E-01	48.17	0.6461E 05	0.1501E 01	0.673E-01
13	120.20	134.50	0.6631E 00	534.5	0.780E-01	47.21	0.6523E 05	0.1531E 01	0.678E-01
14	121.60	135.90	0.5834E 00	534.5	0.808E-01	47.57	0.6762E 05	0.1280E 01	0.696E-01
15	120.50	134.80	0.7270E 00	534.5	0.823E-01	47.22	0.6884E 05	0.1511E 01	0.714E-01
16	121.00	135.30	0.7957E 00	534.5	0.851E-01	47.62	0.7121E 05	0.1551E 01	0.736E-01
17	119.75	134.22	0.8596E 00	535.0	0.877E-01	47.67	0.7332E 05	0.1564E 01	0.765E-01
18	119.00	133.47	0.9136E 00	532.5	0.884E-01	46.87	0.7414E 05	0.1635E 01	0.774E-01
19	120.50	134.97	0.9574E 00	532.0	0.902E-01	46.85	0.7574E 05	0.1665E 01	0.781E-01
20	121.00	135.47	0.1007E 01	531.0	0.928E-01	47.17	0.7797E 05	0.1665E 01	0.799E-01
21	120.10	134.57	0.5880E 02	530.0	0.953E-01	47.54	0.8022E 05	0.9165E 02	0.826E-01
22	120.00	134.47	0.1090E 01	526.5	0.967E-01	47.21	0.8179E 05	0.1660E 01	0.836E-01
23	119.00	133.46	0.1167E 01	527.0	0.993E-01	46.70	0.8390E 05	0.1675E 01	0.865E-01
24	119.50	133.96	0.1310E 01	526.5	0.104E-00	46.57	0.8817E 05	0.1718E 01	0.904E-01
25	120.00	134.44	0.1424E 01	533.0	0.109E-00	46.88	0.9139E 05	0.1687E 01	0.948E-01
26	120.20	134.64	0.1562E 01	532.5	0.113E-00	46.56	0.9470E 05	0.1729E 01	0.980E-01
27	120.00	134.44	0.1695E 01	532.5	0.117E-00	46.68	0.9836E 05	0.1736E 01	0.102E-00
28	119.80	134.24	0.1758E 01	531.5	0.121E-00	46.41	0.1012E 06	0.1705E 01	0.105E-00
29	119.50	133.94	0.1867E 01	531.5	0.123E-00	46.15	0.1037E 06	0.1720E 01	0.108E-00
30	120.30	134.74	0.1965E 01	531.5	0.128E-00	46.33	0.1072E 06	0.1707E 01	0.111E-00
31	120.50	134.94	0.2260E 01	531.0	0.135E-00	45.81	0.1138E 06	0.1747E 01	0.117E-00
32	120.50	134.94	0.2456E 01	531.5	0.141E-00	45.82	0.1183E 06	0.1754E 01	0.122E-00
33	120.50	134.91	0.2652E 01	531.5	0.145E-00	45.69	0.1216E 06	0.1791E 01	0.125E-00
34	120.30	134.71	0.2923E 01	532.0	0.148E-00	45.28	0.1243E 06	0.1881E 01	0.128E-00
35	119.85	134.26	0.3085E 01	532.0	0.152E-00	45.14	0.1272E 06	0.1891E 01	0.132E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT OUTER (8) HOLES (1.1 TO 2.1). AREA FOR 8-0.185 DIA

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.86	0.1670E-00	533.0	0.354E-01	41.47	0.2967E 05	0.1862E 01	0.307E-01
2	120.75	135.11	0.1768E-00	531.5	0.399E-01	41.91	0.3354E 05	0.1573E 01	0.345E-01
3	120.50	134.87	0.2456E-00	531.5	0.440E-01	42.27	0.3699E 05	0.1792E 01	0.381E-01
4	120.20	134.57	0.2947E-00	531.5	0.465E-01	41.38	0.3902E 05	0.1929E 01	0.403E-01
5	121.20	135.57	0.2947E-00	531.5	0.489E-01	40.89	0.4109E 05	0.1752E 01	0.421E-01
6	121.00	135.37	0.3438E-00	531.5	0.538E-01	42.47	0.4517E 05	0.1689E 01	0.464E-01
7	120.75	135.12	0.3566E-00	533.0	0.560E-01	42.13	0.4696E 05	0.1616E 01	0.485E-01
8	121.75	136.11	0.3782E-00	533.0	0.586E-01	42.15	0.4914E 05	0.1568E 01	0.503E-01
9	120.80	135.16	0.3684E-00	533.0	0.638E-01	44.04	0.5346E 05	0.1281E 01	0.551E-01
10	120.75	135.07	0.4028E-00	535.0	0.621E-01	41.40	0.5193E 05	0.1470E 01	0.538E-01
11	120.50	134.82	0.4912E-00	536.5	0.655E-01	42.26	0.5467E 05	0.1605E 01	0.570E-01
12	120.20	134.52	0.4421E-00	536.5	0.675E-01	42.16	0.5635E 05	0.1356E 01	0.589E-01
13	121.50	135.82	0.6238E 00	536.5	0.716E-01	43.40	0.5974E 05	0.1719E 01	0.618E-01
14	120.60	134.92	0.3831E-00	536.0	0.705E-01	41.52	0.5887E 05	0.1083E 01	0.612E-01
15	121.00	135.32	0.3930E-00	536.0	0.764E-01	43.87	0.6384E 05	0.9469E 00	0.662E-01
16	121.00	135.32	0.7417E 00	537.5	0.918E-01	51.49	0.7649E 05	0.1237E 01	0.796E-01
17	120.75	135.04	0.6091E 00	533.0	0.770E-01	41.17	0.6459E 05	0.1450E 01	0.667E-01
18	121.30	135.59	0.5501E 00	531.5	0.807E-01	41.37	0.6782E 05	0.1201E 01	0.695E-01
19	120.60	134.89	0.6877E 00	531.0	0.813E-01	40.09	0.6830E 05	0.1476E 01	0.703E-01
20	120.60	134.89	0.7368E 00	531.0	0.859E-01	40.61	0.7224E 05	0.1413E 01	0.743E-01
21	119.85	134.14	0.9480E 00	531.0	0.915E-01	39.49	0.7690E 05	0.1596E 01	0.796E-01
22	120.75	135.04	0.8350E 00	531.0	0.109E-00	38.79	0.9165E 05	0.9963E 00	0.942E-01
23	120.00	134.29	0.1032E 01	530.0	0.119E-00	38.89	0.1002E 06	0.1029E 01	0.103E-00
24	120.00	134.29	0.1100E 01	530.5	0.124E-00	37.82	0.1042E 06	0.1012E 01	0.108E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT

-NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT OUTER (8) HOLES (1.1 TO 2.1). AREA FOR 8-0.185 DIA

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	133.72	0.1572E 01	535.5	0.354E-01	41.57	0.2961E 05	0.1743E 02	0.310E-01
2	118.00	132.21	0.1179E-00	537.5	0.380E-01	40.31	0.3165E 05	0.1121E 01	0.337E-01
3	120.50	134.71	0.1768E-00	538.0	0.425E-01	41.33	0.3544E 05	0.1364E 01	0.371E-01
4	120.50	134.71	0.2063E-00	538.0	0.437E-01	39.38	0.3636E 05	0.1512E 01	0.381E-01
5	121.50	135.71	0.2210E-00	537.0	0.475E-01	40.14	0.3963E 05	0.1380E 01	0.411E-01
6	121.30	135.51	0.2702E-00	538.0	0.511E-01	40.81	0.4256E 05	0.1454E 01	0.443E-01
7	120.60	134.81	0.2603E-00	536.5	0.517E-01	39.22	0.4312E 05	0.1367E 01	0.449E-01
8	121.90	136.12	0.3537E-00	537.5	0.547E-01	39.74	0.4562E 05	0.1667E 01	0.472E-01
9	120.30	134.52	0.3537E-00	537.5	0.751E-01	52.29	0.6259E 05	0.8755E 00	0.655E-01
10	120.50	134.72	0.3831E-00	536.0	0.701E-01	46.96	0.5853E 05	0.1093E 01	0.610E-01
11	121.10	135.35	0.4175E-00	536.0	0.588E-01	40.89	0.4914E 05	0.1698E 01	0.510E-01
12	121.00	135.25	0.4028E-00	536.0	0.656E-01	43.90	0.5475E 05	0.1319E 01	0.568E-01
13	120.75	135.00	0.3880E-00	536.0	0.625E-01	40.41	0.5219E 05	0.1396E 01	0.543E-01
14	120.00	134.26	0.4814E-00	535.5	0.649E-01	40.58	0.5421E 05	0.1599E 01	0.566E-01
15	120.70	134.96	0.5108E 00	535.5	0.651E-01	39.52	0.5443E 05	0.1693E 01	0.565E-01
16	121.20	135.46	0.3930E-00	535.5	0.690E-01	40.72	0.5764E 05	0.1165E 01	0.597E-01
17	120.00	134.36	0.6386E 00	526.0	0.832E-01	47.23	0.7038E 05	0.1315E 01	0.719E-01
18	120.50	134.86	0.5894E 00	524.0	0.761E-01	42.12	0.6458E 05	0.1460E 01	0.654E-01
19	120.75	135.10	0.7221E 00	524.0	0.740E-01	39.14	0.6280E 05	0.1894E 01	0.635E-01
20	120.75	135.10	0.7859E 00	524.5	0.779E-01	39.61	0.6607E 05	0.1859E 01	0.669E-01
21	120.00	134.35	0.8350E 00	524.5	0.794E-01	38.87	0.6734E 05	0.1891E 01	0.685E-01
22	121.20	135.55	0.9333E 00	523.0	0.825E-01	38.85	0.7010E 05	0.1981E 01	0.705E-01
23	119.50	133.85	0.1228E 01	522.5	0.955E-01	37.71	0.8121E 05	0.1922E 01	0.826E-01
24	120.10	134.44	0.1719E 01	526.0	0.105E-00	37.24	0.8895E 05	0.2217E 01	0.908E-01
25	119.90	134.24	0.1989E 01	525.0	0.113E-00	36.71	0.9557E 05	0.2229E 01	0.975E-01
26	120.60	134.94	0.2333E 01	525.0	0.119E-00	36.20	0.1006E 06	0.2370E 01	0.102E-00
27	120.00	134.34	0.1646E 01	525.0	0.109E-00	36.83	0.9220E 05	0.1983E 01	0.940E-01
28	120.00	134.34	0.2137E 01	524.0	0.117E-00	36.84	0.9961E 05	0.2216E 01	0.101E-00

04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT OUTER (8) HOLES (1.1 TO 2.1). AREA FOR 8-0.185 DIA

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.81	0.1572E-00	528.5	0.354E-01	41.33	0.2983E 05	0.1788E 01	0.305E-01
2	121.00	135.32	0.1572E-00	531.5	0.400E-01	42.07	0.3363E 05	0.1393E 01	0.345E-01
3	120.30	134.61	0.1965E-00	528.0	0.449E-01	43.09	0.3793E 05	0.1383E 01	0.388E-01
4	120.30	134.61	0.1965E-00	527.0	0.516E-01	45.55	0.4357E 05	0.1053E 01	0.445E-01
5	121.50	135.81	0.2702E-00	527.0	0.532E-01	44.35	0.4495E 05	0.1372E 01	0.455E-01
6	121.20	135.51	0.2947E-00	527.0	0.554E-01	43.65	0.4682E 05	0.1376E 01	0.475E-01
7	121.00	135.31	0.2947E-00	527.0	0.589E-01	44.18	0.4981E 05	0.1215E 01	0.506E-01
8	121.30	135.61	0.3433E-00	527.0	0.610E-01	43.68	0.5151E 05	0.1328E 01	0.522E-01
9	120.30	134.64	0.4028E-00	531.5	0.634E-01	43.76	0.5330E 05	0.1414E 01	0.550E-01
10	121.00	135.34	0.4273E-00	529.5	0.669E-01	44.35	0.5633E 05	0.1362E 01	0.576E-01
11	120.60	134.94	0.4421E-00	528.5	0.690E-01	44.17	0.5821E 05	0.1321E 01	0.595E-01
12	121.00	135.35	0.4666E-00	527.5	0.702E-01	43.46	0.5929E 05	0.1354E 01	0.603E-01
13	121.00	135.35	0.5158E 00	527.0	0.732E-01	43.96	0.6184E 05	0.1379E 01	0.628E-01
14	121.10	135.45	0.5649E 00	527.0	0.749E-01	43.72	0.6327E 05	0.1444E 01	0.643E-01
15	121.50	135.85	0.5894E 00	526.0	0.770E-01	43.77	0.6516E 05	0.1431E 01	0.658E-01
16	121.50	135.85	0.5944E 00	526.0	0.780E-01	43.27	0.6603E 05	0.1406E 01	0.667E-01
17	120.00	134.36	0.6877E 00	528.0	0.820E-01	43.53	0.6922E 05	0.1451E 01	0.710E-01
18	120.50	134.86	0.7368E 00	527.5	0.855E-01	43.52	0.7222E 05	0.1436E 01	0.737E-01
19	120.10	134.46	0.7859E 00	527.5	0.874E-01	42.88	0.7382E 05	0.1462E 01	0.756E-01
20	121.10	135.53	0.8449E 00	525.5	0.920E-01	43.33	0.7789E 05	0.1436E 01	0.788E-01
21	121.50	135.93	0.1213E 01	524.5	0.107E-00	42.16	0.9033E 05	0.1545E 01	0.909E-01
22	121.00	135.43	0.1523E 01	524.5	0.117E-00	41.28	0.9930E 05	0.1598E 01	0.100E-00
23	120.75	135.18	0.1842E 01	523.5	0.126E-00	40.76	0.1068E 06	0.1674E 01	0.108E-00
24	120.50	134.93	0.2078E 01	523.5	0.134E-00	40.67	0.1139E 06	0.1660E 01	0.115E-00
25	120.70	135.13	0.1660E 01	524.0	0.122E-00	41.16	0.1036E 06	0.1600E 01	0.105E-00
26	120.00	134.43	0.1916E 01	524.0	0.129E-00	40.45	0.1096E 06	0.1642E 01	0.111E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER	14	NOZZLE END BEARING SHAFT
RUN DATE	NOVEMBER 6, 1963	-NUMBER
		-RING CLEARANCE (INCH)
		0.0064
DRIVE SHAFT		-PLENUM DEPTH (INCH)
-NUMBER	2	0.1314
-DISCHARGE HOLE SIZE (INCH)	0.2500	
FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE		
LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.4 TO 2.2) AREA IS 0.03025 BASED ON RING CLEARANCE		

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	138.79	0.9333E-01	533.5	0.122E-01	14.34	0.5041E 04	0.1802E-00	0.730E-01
2	119.75	135.49	0.1081E-00	533.5	0.124E-01	13.11	0.5142E 04	0.1958E-00	0.763E-01
3	121.20	137.49	0.1375E-00	533.5	0.168E-01	16.20	0.6943E 04	0.1387E-00	0.102E-00
4	121.20	137.69	0.1474E-00	534.5	0.140E-01	12.53	0.5774E 04	0.2142E-00	0.845E-01
5	121.00	137.29	0.1867E-00	534.5	0.164E-01	13.75	0.6755E 04	0.1977E-00	0.992E-01
6	119.50	135.29	0.1965E-00	534.5	0.183E-01	14.52	0.7546E 04	0.1643E-00	0.112E-00
7	122.30	138.49	0.1965E-00	534.5	0.220E-01	16.64	0.9093E 04	0.1158E-00	0.132E-00
8	120.50	136.79	0.2309E-00	534.5	0.232E-01	16.78	0.9591E 04	0.1208E-00	0.141E-00
9	119.00	134.79	0.2702E-00	533.5	0.227E-01	15.71	0.9384E 04	0.1462E-00	0.140E-00
10	120.75	137.05	0.2849E-00	534.5	0.248E-01	16.53	0.1022E 05	0.1315E-00	0.150E-00
11	122.00	138.05	0.2898E-00	534.5	0.256E-01	16.47	0.1055E 05	0.1266E-00	0.154E-00
12	120.00	136.20	0.2996E-00	534.5	0.264E-01	16.47	0.1089E 05	0.1211E-00	0.161E-00
13	120.20	136.40	0.3045E-00	534.5	0.281E-01	17.03	0.1161E 05	0.1085E-00	0.172E-00
14	121.60	137.60	0.3340E-00	534.5	0.285E-01	16.75	0.1174E 05	0.1173E-00	0.172E-00
15	120.50	136.40	0.3684E-00	534.5	0.296E-01	17.01	0.1223E 05	0.1182E-00	0.181E-00
16	121.00	137.30	0.3930E-00	534.5	0.300E-01	16.81	0.1239E 05	0.1236E-00	0.182E-00
17	119.75	135.22	0.3930E-00	535.0	0.311E-01	16.88	0.1280E 05	0.1138E-00	0.191E-00
18	119.00	134.97	0.4028E-00	532.5	0.334E-01	17.74	0.1384E 05	0.1008E-00	0.206E-00
19	120.50	136.57	0.4273E-00	532.0	0.341E-01	17.70	0.1411E 05	0.1043E-00	0.207E-00
20	121.00	136.97	0.4519E-00	531.0	0.349E-01	17.77	0.1448E 05	0.1055E-00	0.211E-00
21	120.10	135.57	0.4617E-00	530.0	0.352E-01	17.57	0.1462E 05	0.1052E-00	0.215E-00
22	120.00	135.57	0.4912E-00	526.5	0.358E-01	17.48	0.1493E 05	0.1090E-00	0.218E-00
23	119.00	133.46	0.5010E 00	527.0	0.378E-01	17.79	0.1576E 05	0.9801E-01	0.234E-00
24	119.50	134.96	0.5894E 00	526.5	0.406E-01	18.12	0.1692E 05	0.1013E-00	0.243E-00
25	120.00	135.19	0.5894E 00	533.0	0.400E-01	17.22	0.1655E 05	0.1030E-00	0.246E-00
26	120.20	135.64	0.6877E 00	532.5	0.434E-01	17.90	0.1795E 05	0.1028E-00	0.266E-00
27	120.00	135.44	0.7368E 00	532.5	0.449E-01	17.86	0.1856E 05	0.1028E-00	0.275E-00
28	119.80	134.94	0.7614E 00	531.5	0.465E-01	17.93	0.1928E 05	0.9856E-01	0.286E-00
29	119.50	134.94	0.7859E 00	531.5	0.468E-01	17.48	0.1938E 05	0.1007E-00	0.288E-00
30	120.30	135.44	0.8350E 00	531.5	0.476E-01	17.28	0.1971E 05	0.1038E-00	0.291E-00
31	120.50	135.19	0.9578E 00	531.0	0.520E-01	17.59	0.2156E 05	0.9963E-01	0.319E-00
32	120.50	135.54	0.1012E 01	531.5	0.539E-01	17.53	0.2231E 05	0.9829E-01	0.330E-00
33	120.50	135.41	0.1081E 01	531.5	0.554E-01	17.47	0.2293E 05	0.9926E-01	0.339E-00
34	120.30	134.91	0.1203E 01	532.0	0.587E-01	17.95	0.2431E 05	0.9777E-01	0.361E-00
35	119.85	134.26	0.1253E 01	532.0	0.607E-01	18.08	0.2512E 05	0.9486E-01	0.375E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT

-NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.4 TO 2.2) AREA IS 0.23468 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.86	0.4912E-02	533.0	0.193E-01	22.59	0.7970E 04	0.2256E-00	0.151E-01
2	120.75	136.96	0.9824E-02	531.5	0.209E-01	21.98	0.8672E 04	0.3840E-00	0.163E-01
3	120.50	136.87	0.1965E-01	531.5	0.225E-01	21.62	0.9327E 04	0.6635E 00	0.176E-01
4	120.20	136.37	0.2456E-01	531.5	0.242E-01	21.55	0.1002E 05	0.7158E 00	0.190E-01
5	121.20	137.37	0.2947E-01	531.5	0.279E-01	23.34	0.1157E 05	0.6496E 00	0.217E-01
6	121.00	137.12	0.3438E-01	531.5	0.283E-01	22.33	0.1171E 05	0.7380E 00	0.220E-01
7	120.75	136.97	0.3438E-01	533.0	0.301E-01	22.66	0.1245E 05	0.6472E 00	0.235E-01
8	121.75	137.66	0.3438E-01	533.0	0.315E-01	22.68	0.1303E 05	0.5939E 00	0.245E-01
9	120.80	136.86	0.4421E-01	533.0	0.295E-01	20.38	0.1220E 05	0.8665E 00	0.231E-01
10	120.75	135.82	0.4912E-01	535.0	0.340E-01	22.65	0.1401E 05	0.7181E 00	0.268E-01
11	120.50	136.82	0.5403E-01	536.5	0.340E-01	21.93	0.1399E 05	0.7928E 00	0.267E-01
12	120.20	136.82	0.4912E-01	536.5	0.348E-01	21.73	0.1432E 05	0.6876E 00	0.273E-01
13	121.50	138.52	0.4912E-01	536.5	0.334E-01	20.24	0.1373E 05	0.7570E 00	0.259E-01
14	120.60	136.82	0.7368E-01	536.0	0.361E-01	21.29	0.1489E 05	0.9570E 00	0.284E-01
15	121.00	137.32	0.7368E-01	536.0	0.335E-01	19.21	0.1378E 05	0.1120E 01	0.262E-01
16	121.00	137.32	0.7859E-01	537.5	0.204E-01	11.43	0.8370E 04	0.3219E 01	0.159E-01
17	120.75	136.79	0.8350E-01	533.0	0.412E-01	22.01	0.1703E 05	0.8399E 00	0.322E-01
18	121.30	136.99	0.8842E-01	531.5	0.430E-01	22.03	0.1781E 05	0.8196E 00	0.336E-01
19	120.60	136.49	0.8942E-01	531.0	0.461E-01	22.74	0.1911E 05	0.7112E 00	0.361E-01
20	120.60	136.49	0.9333E-01	531.0	0.466E-01	22.01	0.1931E 05	0.7352E 00	0.365E-01
21	119.85	135.29	0.9824E-01	531.0	0.534E-01	23.05	0.2214E 05	0.5833E 00	0.422E-01
22	120.75	135.79	0.1474E-00	531.0	0.662E-01	23.57	0.2746E 05	0.5709E 00	0.521E-01
23	120.00	134.89	0.1817E-00	530.0	0.719E-01	23.49	0.2983E 05	0.5953E 00	0.569E-01
24	120.00	134.39	0.1965E-00	530.5	0.800E-01	24.42	0.3317E 05	0.5173E 00	0.636E-01

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.4 TO 2.2) AREA IS 0.59565 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	134.22	0.	535.5	0.184E-01	21.64	0.7602E 04	0.	0.581E-02
2	118.00	135.71	0.1965E-01	537.5	0.219E-01	23.20	0.8982E 04	0.4449E 01	0.682E-02
3	120.50	136.71	0.2456E-01	538.0	0.229E-01	22.21	0.9392E 04	0.5113E 01	0.709E-02
4	120.50	136.81	0.3438E-01	538.0	0.269E-01	24.26	0.1105E 05	0.5177E 01	0.833E-02
5	121.50	137.51	0.5894E-01	537.0	0.278E-01	23.45	0.1142E 05	0.8390E 01	0.855E-02
6	121.30	137.31	0.5894E-01	538.0	0.283E-01	22.59	0.1161E 05	0.8059E 01	0.873E-02
7	120.60	136.71	0.4912E-01	536.5	0.323E-01	24.52	0.1330E 05	0.5136E 01	0.100E-01
8	121.90	137.82	0.8842E-01	537.5	0.329E-01	23.85	0.1350E 05	0.8997E 01	0.101E-01
9	120.30	136.22	0.8842E-01	537.5	0.160E-01	11.16	0.6586E 04	0.3737E 02	0.498E-02
10	120.50	136.42	0.5894E-01	536.0	0.250E-01	16.73	0.1028E 05	0.1032E 02	0.774E-02
11	121.10	137.15	0.4912E-01	536.0	0.324E-01	22.50	0.1334E 05	0.5134E 01	0.999E-02
12	121.00	136.95	0.7368E-01	536.0	0.294E-01	19.67	0.1209E 05	0.9349E 01	0.907E-02
13	120.75	136.75	0.	536.0	0.360E-01	23.27	0.1482E 05	0.	0.111E-01
14	120.00	135.56	0.	535.5	0.371E-01	23.22	0.1529E 05	0.	0.116E-01
15	120.70	136.76	0.9824E-01	535.5	0.384E-01	23.28	0.1581E 05	0.7303E 01	0.119E-01
16	121.20	137.26	0.9824E-01	535.5	0.373E-01	22.04	0.1538E 05	0.7743E 01	0.115E-01
17	120.00	135.56	0.4912E-01	526.0	0.291E-01	16.50	0.1212E 05	0.6422E 01	0.898E-02
18	120.50	136.36	0.2456E-01	524.0	0.401E-01	22.20	0.1679E 05	0.1700E 01	0.123E-01
19	120.75	136.85	0.5894E-01	524.0	0.476E-01	25.66	0.1989E 05	0.2916E 01	0.145E-01
20	120.75	136.35	0.9824E-01	524.5	0.482E-01	24.51	0.2016E 05	0.4704E 01	0.148E-01
21	120.00	135.35	0.7368E-01	524.5	0.514E-01	25.18	0.2151E 05	0.3077E 01	0.159E-01
22	121.20	136.85	0.8842E-01	523.0	0.534E-01	25.13	0.2236E 05	0.3478E 01	0.163E-01
23	119.50	134.35	0.8842E-01	522.5	0.651E-01	25.68	0.2727E 05	0.2301E 01	0.202E-01
24	120.10	134.84	0.8842E-01	526.0	0.735E-01	26.02	0.3065E 05	0.1799E 01	0.228E-01
25	119.90	134.24	0.9824E-01	525.0	0.805E-01	26.21	0.3364E 05	0.1659E 01	0.251E-01
26	120.60	134.74	0.1474E-00	525.0	0.870E-01	26.50	0.3633E 05	0.2142E 01	0.270E-01
27	120.00	134.34	0.9824E-01	525.0	0.772E-01	26.13	0.3226E 05	0.1806E 01	0.241E-01
28	120.00	134.44	0.1375E-00	524.0	0.789E-01	24.77	0.3302E 05	0.2425E 01	0.246E-01

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
-RING CLEARANCE (INCH) 0.2035
-PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.4 TO 2.2) AREA IS 0.95906 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.82	0.	528.5	0.180E-01	20.98	0.7468E 04	0.	0.342E-02
2	121.00	137.06	0.	531.5	0.195E-01	20.50	0.8079E 04	0.	0.372E-02
3	120.30	136.61	0.	528.0	0.199E-01	19.05	0.8270E 04	0.	0.379E-02
4	120.30	136.61	0.	527.0	0.193E-01	17.04	0.8035E 04	0.	0.368E-02
5	121.50	137.61	0.	527.0	0.215E-01	17.94	0.8967E 04	0.	0.407E-02
6	121.20	137.31	0.	527.0	0.239E-01	18.80	0.9946E 04	0.	0.453E-02
7	121.00	137.11	0.4912E-02	527.0	0.255E-01	19.13	0.1063E 05	0.2179E 01	0.485E-02
8	121.30	134.61	0.9824E-02	527.0	0.268E-01	19.23	0.1118E 05	0.3867E 01	0.519E-02
9	120.30	136.34	0.1474E-01	531.5	0.275E-01	18.94	0.1137E 05	0.5567E 01	0.527E-02
10	121.00	137.09	0.1965E-01	529.5	0.290E-01	18.60	0.1165E 05	0.7180E 01	0.534E-02
11	120.60	136.74	0.1965E-01	528.5	0.298E-01	19.09	0.1241E 05	0.6340E 01	0.569E-02
12	121.00	136.85	0.1965E-01	527.5	0.314E-01	19.44	0.1308E 05	0.5737E 01	0.598E-02
13	121.00	136.85	0.1965E-01	527.0	0.319E-01	19.17	0.1330E 05	0.5559E 01	0.608E-02
14	121.10	137.10	0.1965E-01	527.0	0.343E-01	20.03	0.1429E 05	0.4822E 01	0.652E-02
15	121.50	137.55	0.2456E-01	526.0	0.348E-01	19.78	0.1452E 05	0.5885E 01	0.659E-02
16	121.50	137.35	0.2456E-01	526.0	0.370E-01	20.53	0.1545E 05	0.5194E 01	0.702E-02
17	120.00	135.36	0.2456E-01	528.0	0.346E-01	18.34	0.1438E 05	0.5856E 01	0.666E-02
18	120.50	136.11	0.2456E-01	527.5	0.401E-01	20.42	0.1671E 05	0.4369E 01	0.768E-02
19	120.10	135.86	0.2456E-01	527.5	0.417E-01	20.44	0.1735E 05	0.4045E 01	0.799E-02
20	121.10	135.53	0.2456E-01	525.5	0.393E-01	18.49	0.1639E 05	0.4564E 01	0.753E-02
21	121.50	136.93	0.4912E-01	524.5	0.552E-01	21.84	0.2308E 05	0.4673E 01	0.105E-01
22	121.00	135.93	0.7368E-01	524.5	0.656E-01	23.11	0.2741E 05	0.4932E 01	0.125E-01
23	120.75	135.43	0.7368E-01	523.5	0.715E-01	23.15	0.2993E 05	0.4140E 01	0.137E-01
24	120.50	135.18	0.8842E-01	523.5	0.750E-01	22.72	0.3137E 05	0.4513E 01	0.144E-01
25	120.70	135.13	0.4912E-01	524.0	0.655E-01	22.07	0.2740E 05	0.3278E 01	0.126E-01
26	120.00	134.83	0.7859E-01	524.0	0.706E-01	22.09	0.2952E 05	0.4508E 01	0.136E-01

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
 RUN DATE NOVEMBER 14, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 1
 -RING CLEARANCE (INCH) 0.0064
 -PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.3 TO 3.1) AREA IS 0.03025 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	138.79	0.2702E-00	533.5	0.122E-01	14.34	0.5041E 04	0.5217E 00	0.730E-01
2	119.75	135.49	0.3045E-00	533.5	0.124E-01	13.11	0.5142E 04	0.5518E 00	0.763E-01
3	121.20	137.49	0.3831E-00	533.5	0.168E-01	16.20	0.6943E 04	0.3863E-00	0.102E-00
4	121.20	137.69	0.4814E-00	534.5	0.140E-01	12.53	0.5774E 04	0.6996E 00	0.845E-01
5	121.00	137.29	0.4814E-00	534.5	0.164E-01	13.75	0.6755E 04	0.5098E 00	0.992E-01
6	119.50	135.59	0.6386E 00	534.5	0.183E-01	14.52	0.7546E 04	0.5351E 00	0.112E-00
7	122.30	138.49	0.6877E 00	534.5	0.220E-01	16.64	0.9093E 04	0.4054E-00	0.132E-00
8	120.50	136.79	0.6975E 00	534.5	0.232E-01	16.78	0.9591E 04	0.3650E-00	0.141E-00
9	119.00	134.80	0.8596E 00	533.5	0.226E-01	15.61	0.9325E 04	0.4711E-00	0.139E-00
10	120.75	137.05	0.8252E 00	534.5	0.248E-01	16.53	0.1022E 05	0.3808E-00	0.150E-00
11	122.00	138.05	0.9775E 00	534.5	0.256E-01	16.47	0.1055E 05	0.4269E-00	0.154E-00
12	120.00	136.20	0.1135E 01	534.5	0.258E-01	16.10	0.1065E 05	0.4794E-00	0.158E-00
13	120.20	136.40	0.1189E 01	534.5	0.241E-01	17.03	0.1161E 05	0.4236E-00	0.172E-00
14	121.60	137.60	0.1022E 01	534.5	0.285E-01	16.75	0.1174E 05	0.3589E-00	0.172E-00
15	120.50	136.40	0.1144E 01	534.5	0.296E-01	17.01	0.1223E 05	0.3671E-00	0.181E-00
16	121.00	137.30	0.1326E 01	534.5	0.300E-01	16.81	0.1239E 05	0.4173E-00	0.182E-00
17	119.75	135.22	0.1277E 01	535.0	0.311E-01	16.88	0.1280E 05	0.3698E-00	0.191E-00
18	119.00	134.97	0.1410E 01	532.5	0.334E-01	17.74	0.1384E 05	0.3529E-00	0.206E-00
19	120.50	136.57	0.1444E 01	532.0	0.341E-01	17.70	0.1411E 05	0.3523E-00	0.207E-00
20	121.00	136.97	0.1434E 01	531.0	0.349E-01	17.77	0.1448E 05	0.3348E-00	0.211E-00
21	120.10	135.57	0.1518E 01	530.0	0.352E-01	17.57	0.1462E 05	0.3459E-00	0.215E-00
22	120.00	135.57	0.1655E 01	526.5	0.358E-01	17.48	0.1493E 05	0.3672E-00	0.218E-00
23	119.00	134.76	0.1803E 01	527.0	0.378E-01	17.79	0.1576E 05	0.3561E-00	0.232E-00
24	119.50	134.96	0.1916E 01	526.5	0.399E-01	17.80	0.1665E 05	0.3402E-00	0.244E-00
25	120.00	135.19	0.2063E 01	533.0	0.400E-01	17.22	0.1655E 05	0.3606E-00	0.246E-00
26	120.20	135.64	0.2260E 01	532.5	0.434E-01	17.90	0.1795E 05	0.3377E-00	0.266E-00
27	120.00	135.44	0.2358E 01	532.5	0.449E-01	17.86	0.1856E 05	0.3291E-00	0.275E-00
28	119.80	134.94	0.2652E 01	531.5	0.465E-01	17.93	0.1928E 05	0.3434E-00	0.286E-00
29	119.50	134.94	0.2603E 01	531.5	0.468E-01	17.48	0.1938E 05	0.3336E-00	0.288E-00
30	120.30	135.44	0.2726E 01	531.5	0.476E-01	17.28	0.1971E 05	0.3390E-00	0.291E-00
31	120.50	135.19	0.3316E 01	531.0	0.520E-01	17.59	0.2156E 05	0.3449E-00	0.319E-00
32	120.50	135.54	0.3468E 01	531.5	0.539E-01	17.53	0.2231E 05	0.3368E-00	0.330E-00
33	120.50	135.41	0.3782E 01	531.5	0.554E-01	17.47	0.2293E 05	0.3474E-00	0.339E-00
34	120.30	134.91	0.4052E 01	532.0	0.587E-01	17.95	0.2431E 05	0.3292E-00	0.361E-00
35	119.85	134.26	0.4298E 01	532.0	0.607E-01	18.08	0.2512E 05	0.3255E-00	0.375E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
RUN DATE NOVEMBER 14, 1963
DRIVE SHAFT
-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500
NOZZLE END BEARING SHAFT
-NUMBER 2
-RING CLEARANCE (INCH) 0.0498
-PLENUM DEPTH (INCH) 0.1748
FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.3 TO 3.1) AREA IS 0.23468 BASED ON RING CLEARAN

	P1 PSIG	PXA PSIA	DELXPY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	PACH
1	120.50	136.86	0.1768E-00	533.0	0.193E-01	22.59	0.7970E 04	0.8123E 01	0.151E-01
2	120.75	136.96	0.2554E-00	531.5	0.209E-01	21.98	0.8672E 04	0.9983E 01	0.163E-01
3	120.50	136.87	0.2800E-00	531.5	0.225E-01	21.62	0.9327E 04	0.9454E 01	0.176E-01
4	120.20	136.37	0.4077E-00	531.5	0.242E-01	21.55	0.1002E 05	0.1188E 02	0.190E-01
5	121.20	137.37	0.4519E-00	531.5	0.279E-01	23.34	0.1157E 05	0.9961E 01	0.217E-01
6	121.00	137.12	0.5108E 00	531.5	0.283E-01	22.33	0.1171E 05	0.1097E 02	0.220E-01
7	120.75	136.97	0.5256E 00	533.0	0.301E-01	22.66	0.1245E 05	0.9893E 01	0.235E-01
8	121.75	137.66	0.7221E 00	533.0	0.315E-01	22.68	0.1303E 05	0.1247E 02	0.245E-01
9	120.80	136.86	0.7908E 00	533.0	0.295E-01	20.38	0.1220E 05	0.1550E 02	0.231E-01
10	120.75	135.82	0.7368E 00	535.0	0.340E-01	22.65	0.1401E 05	0.1077E 02	0.268E-01
11	120.50	136.82	0.6680E 00	536.5	0.340E-01	21.93	0.1399E 05	0.9801E 01	0.267E-01
12	120.20	136.82	0.8842E 00	536.5	0.359E-01	22.43	0.1479E 05	0.1161E 02	0.282E-01
13	121.50	138.52	0.1120E 01	536.5	0.334E-01	20.24	0.1373E 05	0.1726E 02	0.259E-01
14	120.60	136.82	0.1056E 01	536.0	0.361E-01	21.29	0.1489E 05	0.1372E 02	0.284E-01
15	121.00	137.32	0.1056E 01	536.0	0.335E-01	19.21	0.1378E 05	0.1606E 02	0.262E-01
16	121.00	137.32	0.1208E 01	537.5	0.204E-01	11.43	0.8370E 04	0.4949E 02	0.159E-01
17	120.75	136.79	0.9185E 00	533.0	0.412E-01	22.01	0.1703E 05	0.9239E 01	0.322E-01
18	121.30	136.99	0.1464E 01	531.5	0.430E-01	22.03	0.1781E 05	0.1357E 02	0.336E-01
19	120.60	136.49	0.1415E 01	531.0	0.461E-01	22.74	0.1911E 05	0.1138E 02	0.361E-01
20	120.60	136.49	0.1763E 01	531.0	0.466E-01	22.01	0.1931E 05	0.1389E 02	0.365E-01
21	119.85	135.29	0.1719E 01	531.0	0.534E-01	23.05	0.2214E 05	0.1021E 02	0.422E-01
22	120.75	135.79	0.2898E 01	531.0	0.662E-01	23.57	0.2746E 05	0.1123E 02	0.521E-01
23	120.00	134.89	0.3129E 01	530.0	0.719E-01	23.49	0.2983E 05	0.1025E 02	0.569E-01
24	120.00	134.39	0.3782E 01	530.5	0.800E-01	24.42	0.3317E 05	0.9958E 01	0.636E-01

W
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WANI-TWE-715

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.3 TO 3.1) AREA IS 0.59565 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTH	REYN	COEFPL	MACH
1	119.50	134.22	0.1817E-00	535.5	0.184E-01	21.64	0.7602E 04	0.5733E 02	0.581E-02
2	118.00	135.71	0.2407E-00	537.5	0.219E-01	23.20	0.8982E 04	0.5450E 02	0.682E-02
3	120.50	136.71	0.3291E-00	538.0	0.229E-01	22.21	0.9392E 04	0.6851E 02	0.709E-02
4	120.50	136.81	0.3782E-00	538.0	0.269E-01	24.26	0.1105E 05	0.5695E 02	0.833E-02
5	121.50	137.51	0.4519E-00	537.0	0.278E-01	23.45	0.1142E 05	0.6433E 02	0.855E-02
6	121.30	137.31	0.4666E-00	538.0	0.283E-01	22.59	0.1161E 05	0.6380E 02	0.873E-02
7	120.60	136.71	0.5796E 00	536.5	0.323E-01	24.52	0.1330E 05	0.6061E 02	0.100E-01
8	121.90	137.82	0.6287E 00	537.5	0.336E-01	24.41	0.1382E 05	0.6107E 02	0.103E-01
9	120.30	136.22	0.6287E 00	537.5	0.160E-01	11.16	0.6586E 04	0.2658E 03	0.498E-02
10	120.50	136.42	0.7957E 00	536.0	0.250E-01	16.73	0.1028E 05	0.1393E 03	0.774E-02
11	121.10	137.15	0.6779E 00	536.0	0.324E-01	22.50	0.1334E 05	0.7085E 02	0.999E-02
12	121.00	136.95	0.7614E 00	536.0	0.294E-01	19.67	0.1209E 05	0.9661E 02	0.907E-02
13	120.75	136.75	0.8105E 00	536.0	0.360E-01	23.27	0.1482E 05	0.6841E 02	0.111E-01
14	120.00	134.26	0.8842E 00	535.5	0.371E-01	23.22	0.1529E 05	0.6893E 02	0.117E-01
15	120.70	135.26	0.9333E 00	535.5	0.384E-01	23.28	0.1581E 05	0.6861E 02	0.120E-01
16	121.20	135.46	0.9824E 00	535.5	0.373E-01	22.04	0.1538E 05	0.7641E 02	0.116E-01
17	120.00	134.36	0.1032E 01	526.0	0.291E-01	16.50	0.1212E 05	0.1337E 03	0.906E-02
18	120.50	134.76	0.1105E 01	524.0	0.128E-00	70.93	0.5363E 05	0.7405E 01	0.398E-01
19	120.75	135.10	0.1203E 01	524.0	0.476E-01	25.14	0.1989E 05	0.5878E 02	0.147E-01
20	120.75	134.95	0.1375E 01	524.5	0.482E-01	24.51	0.2016E 05	0.6518E 02	0.150E-01
21	120.00	134.10	0.1474E 01	524.5	0.514E-01	25.18	0.2151E 05	0.6097E 02	0.161E-01
22	121.20	134.95	0.1523E 01	523.0	0.534E-01	25.13	0.2236E 05	0.5907E 02	0.165E-01
23	119.50	132.85	0.2309E 01	522.5	0.651E-01	25.68	0.2727E 05	0.5941E 02	0.204E-01
24	120.10	133.54	0.2874E 01	526.0	0.735E-01	26.02	0.3065E 05	0.5791E 02	0.230E-01
25	119.90	132.84	0.3463E 01	525.0	0.805E-01	26.21	0.3364E 05	0.5787E 02	0.254E-01
26	120.60	133.34	0.4003E 01	525.0	0.870E-01	26.50	0.3633E 05	0.5758E 02	0.273E-01
27	120.00	132.94	0.3168E 01	525.0	0.772E-01	26.13	0.3226E 05	0.5764E 02	0.243E-01
28	120.00	133.04	0.3635E 01	524.0	0.789E-01	24.77	0.3302E 05	0.6343E 02	0.248E-01

WANT-TIME-715

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR NOZZLE END BEARING SHAFT RING (2.3 TO 3.1) AREA IS 0.95906 BASED ON RING CLEARANCE

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFFPL	PACH
1	120.50	135.12	0.1817E-00	528.5	0.180E-01	20.98	0.7468E 04	0.1600E 03	0.347E-02
2	121.00	135.81	0.2407E-00	531.5	0.195E-01	20.50	0.8079E 04	0.1795E 03	0.376E-02
3	120.30	135.01	0.2702E-00	528.0	0.199E-01	19.05	0.8270E 04	0.1942E 03	0.384E-02
4	120.30	135.01	0.3242E-00	527.0	0.193E-01	17.04	0.8035E 04	0.2480E 03	0.372E-02
5	121.50	136.31	0.3831E-00	527.0	0.215E-01	17.94	0.8967E 04	0.2376E 03	0.411E-02
6	121.20	135.61	0.4323E-00	527.0	0.239E-01	18.80	0.9946E 04	0.2168E 03	0.458E-02
7	121.00	135.51	0.4912E-00	527.0	0.255E-01	19.13	0.1063E 05	0.2153E 03	0.491E-02
8	121.30	135.61	0.5403E 00	527.0	0.268E-01	19.23	0.1118E 05	0.2143E 03	0.516E-02
9	120.30	135.04	0.5894E 00	531.5	0.275E-01	18.94	0.1137E 05	0.2206E 03	0.532E-02
10	121.00	135.34	0.6631E 00	529.5	0.280E-01	18.60	0.1165E 05	0.2392E 03	0.541E-02
11	120.60	135.14	0.7122E 00	528.5	0.298E-01	19.09	0.1241E 05	0.2271E 03	0.576E-02
12	121.00	135.35	0.7368E 00	527.5	0.314E-01	19.44	0.1308E 05	0.2128E 03	0.605E-02
13	121.00	135.35	0.8105E 00	527.0	0.319E-01	19.17	0.1330E 05	0.2268E 03	0.614E-02
14	121.10	135.35	0.8596E 00	527.0	0.343E-01	20.03	0.1429E 05	0.2083E 03	0.660E-02
15	121.50	135.85	0.9333E 00	526.0	0.348E-01	19.78	0.1452E 05	0.2209E 03	0.667E-02
16	121.50	135.85	0.9824E 00	526.0	0.370E-01	20.53	0.1545E 05	0.2055E 03	0.709E-02
17	120.00	133.86	0.1032E 01	528.0	0.346E-01	18.34	0.1438E 05	0.2432E 03	0.673E-02
18	120.50	134.86	0.1228E 01	527.5	0.401E-01	20.42	0.1671E 05	0.2165E 03	0.775E-02
19	120.10	134.36	0.1336E 01	527.5	0.417E-01	20.44	0.1735E 05	0.2176E 03	0.808E-02
20	121.10	135.18	0.1326E 01	525.5	0.393E-01	18.49	0.1639E 05	0.2458E 03	0.755E-02
21	121.50	135.03	0.2112E 01	524.5	0.552E-01	21.84	0.2308E 05	0.1982E 03	0.106E-01
22	121.00	134.43	0.2923E 01	524.5	0.656E-01	23.11	0.2741E 05	0.1935E 03	0.127E-01
23	120.75	134.18	0.3389E 01	523.5	0.715E-01	23.15	0.2993E 05	0.1887E 03	0.138E-01
24	120.50	133.73	0.3733E 01	523.5	0.750E-01	22.72	0.3137E 05	0.1885E 03	0.145E-01
25	120.70	134.18	0.2996E 01	524.0	0.655E-01	22.07	0.2740E 05	0.1986E 03	0.127E-01
26	120.00	133.43	0.3635E 01	524.0	0.706E-01	22.09	0.2952E 05	0.2063E 03	0.137E-01

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
RUN DATE NOVEMBER 14, 1963

NOZZLE END BEARING SHAFT

-NUMBER

1

-RING CLEARANCE (INCH)

0.0064

-PLENUM DEPTH (INCH)

0.1314

DRIVE SHAFT

-NUMBER

2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 3.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	137.04	0.1768E-00	533.5	0.540E-01	63.48	0.4651E 05	0.7781E 00	0.487E-01
2	119.75	134.09	0.1965E-00	533.5	0.603E-01	63.59	0.5198E 05	0.6775E 00	0.556E-01
3	121.20	135.49	0.2456E-00	533.5	0.668E-01	64.45	0.5757E 05	0.6975E 00	0.610E-01
4	121.20	135.79	0.2947E-00	534.5	0.715E-01	64.05	0.6151E 05	0.7315E 00	0.651E-01
5	121.00	135.29	0.2947E-00	534.5	0.771E-01	64.80	0.6636E 05	0.6262E 00	0.705E-01
6	119.50	133.99	0.4421E-00	534.5	0.809E-01	64.21	0.6956E 05	0.8466E 00	0.746E-01
7	122.30	136.59	0.4912E-00	534.5	0.854E-01	64.53	0.7351E 05	0.8587E 00	0.774E-01
8	120.50	134.79	0.4666E-00	534.5	0.890E-01	64.28	0.7659E 05	0.7415E 00	0.817E-01
9	119.00	133.30	0.5894E 00	533.5	0.927E-01	64.14	0.7989E 05	0.8554E 00	0.860E-01
10	120.75	135.05	0.5403E 00	534.5	0.965E-01	64.39	0.8301E 05	0.7325E 00	0.884E-01
11	122.00	136.10	0.6877E 00	534.5	0.100E-00	64.55	0.8618E 05	0.8715E 00	0.910E-01
12	120.00	134.30	0.8350E 00	534.5	0.103E-00	64.51	0.8895E 05	0.9803E 00	0.952E-01
13	120.20	134.50	0.8842E 00	534.5	0.106E-00	64.24	0.9127E 05	0.9874E 00	0.976E-01
14	121.60	135.80	0.6877E 00	534.5	0.109E-00	64.32	0.9400E 05	0.7309E 00	0.995E-01
15	120.50	134.50	0.7761E 00	534.5	0.112E-00	64.23	0.9628E 05	0.7788E 00	0.103E-00
16	121.00	135.30	0.9333E 00	534.5	0.115E-00	64.42	0.9905E 05	0.8902E 00	0.105E-00
17	119.75	134.07	0.9842E 00	535.0	0.119E-00	64.55	0.1021E 06	0.7850E 00	0.110E-00
18	119.00	132.97	0.9578E 00	532.5	0.122E-00	64.61	0.1051E 06	0.8051E 00	0.113E-00
19	120.50	134.47	0.1017E 01	532.0	0.124E-00	64.55	0.1073E 06	0.8306E 00	0.114E-00
20	121.00	134.77	0.9824E 00	531.0	0.128E-00	64.94	0.1104E 06	0.7637E 00	0.117E-00
21	120.10	134.17	0.1056E 01	530.0	0.131E-00	65.11	0.1130E 06	0.7838E 00	0.120E-00
22	120.00	134.17	0.1164E 01	526.5	0.133E-00	64.69	0.1152E 06	0.8435E 00	0.121E-00
23	119.00	132.86	0.1302E 01	527.0	0.137E-00	64.49	0.1191E 06	0.8719E 00	0.127E-00
24	119.50	132.96	0.1326E 01	526.5	0.145E-00	64.46	0.1257E 06	0.8002E 00	0.133E-00
25	120.00	133.44	0.1474E 01	533.0	0.149E-00	64.10	0.1285E 06	0.8296E 00	0.138E-00
26	120.20	133.54	0.1572E 01	532.5	0.156E-00	64.46	0.1348E 06	0.8062E 00	0.144E-00
27	120.00	133.44	0.1621E 01	532.5	0.162E-00	64.54	0.1398E 06	0.7720E 00	0.150E-00
28	119.80	132.84	0.1891E 01	531.5	0.167E-00	64.34	0.1443E 06	0.8458E 00	0.155E-00
29	119.50	132.44	0.1817E 01	531.5	0.170E-00	63.64	0.1471E 06	0.7802E 00	0.159E-00
30	120.30	133.44	0.1891E 01	531.5	0.175E-00	63.60	0.1513E 06	0.7731E 00	0.162E-00
31	120.50	132.94	0.2358E 01	531.0	0.187E-00	63.40	0.1619E 06	0.8396E 00	0.174E-00
32	120.50	133.19	0.2456E 01	531.5	0.195E-00	63.35	0.1681E 06	0.8113E 00	0.180E-00
33	120.50	133.01	0.2702E 01	531.5	0.200E-00	63.16	0.1729E 06	0.8429E 00	0.186E-00
34	120.30	132.26	0.2849E 01	532.0	0.207E-00	63.24	0.1785E 06	0.8269E 00	0.193E-00
35	119.85	131.41	0.3045E 01	532.0	0.212E-00	63.22	0.1832E 06	0.8344E 00	0.199E-00

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WANI-TME-111

Astronuclear

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 14, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 3.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.96	0.1719E-00	533.0	0.547E-01	64.06	0.4712E 05	0.7275E 00	0.500E-01
2	120.75	135.36	0.2456E-00	531.5	0.609E-01	63.88	0.5256E 05	0.8435E 00	0.555E-01
3	120.50	134.97	0.2603E-00	531.5	0.666E-01	63.89	0.5748E 05	0.7455E 00	0.608E-01
4	120.20	134.57	0.3831E-00	531.5	0.706E-01	62.94	0.6102E 05	0.9708E 00	0.648E-01
5	121.20	135.57	0.4175E-00	531.5	0.768E-01	64.22	0.6636E 05	0.9009E 00	0.699E-01
6	121.00	135.37	0.4765E-00	531.5	0.820E-01	64.80	0.7086E 05	0.9004E 00	0.748E-01
7	120.75	135.12	0.4912E-00	533.0	0.861E-01	64.79	0.7425E 05	0.8383E 00	0.787E-01
8	121.75	136.11	0.6877E 00	533.0	0.901E-01	64.83	0.7770E 05	0.1080E 01	0.818E-01
9	120.80	135.11	0.7466E 00	533.0	0.933E-01	64.42	0.8040E 05	0.1087E 01	0.853E-01
10	120.75	134.32	0.6877E 00	535.0	0.961E-01	64.06	0.8261E 05	0.9341E 00	0.885E-01
11	120.50	134.92	0.6140E 00	536.5	0.995E-01	64.20	0.8537E 05	0.7791E 00	0.914E-01
12	120.20	134.82	0.8350E 00	536.5	0.102E-00	63.89	0.8780E 05	0.1001E 01	0.940E-01
13	121.50	136.82	0.1071E 01	536.5	0.105E-00	63.64	0.9006E 05	0.1238E 01	0.951E-01
14	120.60	134.92	0.9824E 00	536.0	0.107E-00	62.81	0.9156E 05	0.1086E 01	0.979E-01
15	121.00	135.52	0.9824E 00	536.0	0.110E-00	63.08	0.9437E 05	0.1027E 01	0.100E-00
16	121.00	135.82	0.1130E 01	537.5	0.112E-00	62.92	0.9609E 05	0.1134E 01	0.102E-00
17	120.75	134.99	0.8350E 00	533.0	0.118E-00	63.19	0.1019E 06	0.7556E 00	0.108E-00
18	121.30	135.39	0.1375E 01	531.5	0.124E-00	63.41	0.1069E 06	0.1143E 01	0.113E-00
19	120.60	134.79	0.1326E 01	531.0	0.127E-00	62.84	0.1101E 06	0.1037E 01	0.116E-00
20	120.60	134.69	0.1670E 01	531.0	0.133E-00	62.62	0.1145E 06	0.1205E 01	0.121E-00
21	119.85	134.09	0.1621E 01	531.0	0.145E-00	62.54	0.1252E 06	0.9737E 00	0.133E-00
22	120.75	134.29	0.2751E 01	531.0	0.175E-00	62.36	0.1515E 06	0.1131E 01	0.161E-00
23	120.00	133.29	0.2947E 01	530.0	0.191E-00	62.38	0.1652E 06	0.1016E 01	0.176E-00
24	120.00	132.79	0.3586E 01	530.5	0.204E-00	62.24	0.1763E 06	0.1079E 01	0.189E-00

D4.1 CONTROL DRUM -- DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT
 --NUMBER 3
 --RING CLEARANCE (INCH) 0.1264
 --PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT
 --NUMBER 2
 --DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 3.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	132.72	0.1817E-00	535.5	0.539E-01	63.22	0.4630E 05	0.7749E 00	0.503E-01
2	118.00	134.21	0.2210E-00	537.5	0.598E-01	63.51	0.5127E 05	0.7701E 00	0.553E-01
3	120.50	134.96	0.3045E-00	538.0	0.654E-01	63.55	0.5602E 05	0.8917E 00	0.601E-01
4	120.50	134.71	0.3438E-00	538.0	0.705E-01	63.64	0.6042E 05	0.8640E 00	0.650E-01
5	121.50	135.91	0.3930E-00	537.0	0.753E-01	63.59	0.6455E 05	0.8766E 00	0.687E-01
6	121.30	135.71	0.4077E-00	538.0	0.794E-01	63.40	0.6797E 05	0.8155E 00	0.726E-01
7	120.60	134.81	0.5305E 00	536.5	0.840E-01	63.74	0.7206E 05	0.9442E 00	0.772E-01
8	121.90	136.22	0.5403E 00	537.5	0.876E-01	63.59	0.7506E 05	0.8915E 00	0.798E-01
9	120.30	134.52	0.5403E 00	537.5	0.911E-01	63.45	0.7808E 05	0.8136E 00	0.840E-01
10	120.50	134.72	0.7368E 00	536.0	0.950E-01	63.69	0.8161E 05	0.1024E 01	0.874E-01
11	121.10	133.65	0.7122E 00	536.0	0.912E-01	63.39	0.7833E 05	0.1066E 01	0.845E-01
12	121.00	134.25	0.8105E 00	536.0	0.949E-01	63.57	0.8151E 05	0.1125E 01	0.876E-01
13	120.75	134.75	0.8596E 00	536.0	0.985E-01	63.67	0.8456E 05	0.1113E 01	0.905E-01
14	120.00	134.26	0.9097E 00	535.5	0.102E-00	63.79	0.8763E 05	0.1094E 01	0.940E-01
15	120.70	134.96	0.9824E 00	535.5	0.103E-00	62.81	0.8892E 05	0.1155E 01	0.949E-01
16	121.20	135.46	0.9873E 00	535.5	0.106E-00	62.75	0.9133E 05	0.1104E 01	0.971E-01
17	120.00	134.36	0.1081E 01	526.0	0.112E-00	63.73	0.9763E 05	0.1094E 01	0.102E-00
18	120.50	134.86	0.1130E 01	524.0	0.116E-00	64.08	0.1010E 06	0.1082E 01	0.105E-00
19	120.75	135.10	0.1228E 01	524.0	0.122E-00	64.28	0.1060E 06	0.1070E 01	0.110E-00
20	120.75	134.95	0.1400E 01	524.5	0.126E-00	64.11	0.1100E 06	0.1130E 01	0.115E-00
21	120.00	134.15	0.1523E 01	524.5	0.131E-00	64.04	0.1141E 06	0.1136E 01	0.120E-00
22	121.20	135.10	0.1547E 01	523.0	0.136E-00	63.98	0.1187E 06	0.1081E 01	0.123E-00
23	119.50	132.85	0.2284E 01	522.5	0.161E-00	63.39	0.1404E 06	0.1125E 01	0.148E-00
24	120.10	133.34	0.2874E 01	526.0	0.179E-00	63.25	0.1554E 06	0.1141E 01	0.164E-00
25	119.90	132.74	0.3438E 01	525.0	0.193E-00	62.92	0.1684E 06	0.1162E 01	0.179E-00
26	120.60	133.09	0.3905E 01	525.0	0.206E-00	62.70	0.1792E 06	0.1168E 01	0.190E-00
27	120.00	132.84	0.3266E 01	525.0	0.186E-00	62.97	0.1621E 06	0.1193E 01	0.172E-00
28	120.00	132.84	0.3782E 01	524.0	0.196E-00	61.61	0.1713E 06	0.1242E 01	0.181E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
-RING CLEARANCE (INCH) 0.2035
-PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 3.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.92	0.2358E-00	528.5	0.533E-01	62.32	0.4625E 05	0.1057E 01	0.486E-01
2	121.00	135.51	0.2947E-00	531.5	0.595E-01	62.56	0.5141E 05	0.1059E 01	0.542E-01
3	120.30	134.81	0.3193E-00	528.0	0.648E-01	62.14	0.5624E 05	0.9690E 00	0.591E-01
4	120.30	134.81	0.3684E-00	527.0	0.708E-01	62.58	0.6155E 05	0.9378E 00	0.645E-01
5	121.50	136.06	0.3831E-00	527.0	0.747E-01	62.29	0.6492E 05	0.8849E 00	0.674E-01
6	121.20	135.51	0.4666E-00	527.0	0.793E-01	62.45	0.6888E 05	0.9534E 00	0.719E-01
7	121.00	135.41	0.5305E 00	527.0	0.845E-01	63.31	0.7338E 05	0.9543E 00	0.766E-01
8	121.30	135.61	0.6140E 00	527.0	0.878E-01	62.91	0.7628E 05	0.1024E 01	0.795E-01
9	120.30	134.64	0.6533E 00	531.5	0.909E-01	62.70	0.7851E 05	0.1000E 01	0.833E-01
10	121.00	135.34	0.7024E 00	529.5	0.949E-01	62.95	0.8221E 05	0.9950E 00	0.864E-01
11	120.60	134.94	0.7368E 00	528.5	0.989E-01	63.27	0.8572E 05	0.9613E 00	0.901E-01
12	121.00	135.15	0.8350E 00	527.5	0.102E-00	62.91	0.8823E 05	0.1035E 01	0.924E-01
13	121.00	135.10	0.8596E 00	527.0	0.105E-00	63.13	0.9132E 05	0.9962E 00	0.956E-01
14	121.10	135.35	0.9087E 00	527.0	0.109E-00	63.75	0.9486E 05	0.9778E 00	0.991E-01
15	121.50	135.85	0.9578E 00	526.0	0.112E-00	63.55	0.9728E 05	0.9881E 00	0.101E-00
16	121.50	135.75	0.1032E 01	526.0	0.115E-00	63.80	0.1001E 06	0.1004E 01	0.104E-00
17	120.00	134.16	0.1056E 01	528.0	0.117E-00	61.87	0.1011E 06	0.9863E 00	0.107E-00
18	120.50	134.86	0.1253E 01	527.5	0.126E-00	63.94	0.1091E 06	0.1013E 01	0.114E-00
19	120.10	134.36	0.1375E 01	527.5	0.129E-00	63.31	0.1121E 06	0.1050E 01	0.118E-00
20	121.10	135.18	0.1351E 01	525.5	0.131E-00	61.82	0.1143E 06	0.1007E 01	0.119E-00
21	121.50	135.03	0.2137E 01	524.5	0.162E-00	64.00	0.1410E 06	0.1050E 01	0.147E-00
22	121.00	134.43	0.2923E 01	524.5	0.183E-00	64.38	0.1592E 06	0.1121E 01	0.167E-00
23	120.75	133.93	0.3438E 01	523.5	0.197E-00	63.91	0.1723E 06	0.1128E 01	0.180E-00
24	120.50	133.43	0.3880E 01	523.5	0.209E-00	63.39	0.1825E 06	0.1130E 01	0.192E-00
25	120.70	134.18	0.2972E 01	524.0	0.188E-00	63.23	0.1637E 06	0.1079E 01	0.171E-00
26	120.00	133.33	0.3438E 01	524.0	0.200E-00	62.55	0.1743E 06	0.1095E 01	0.184E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER	14	NOZZLE END BEARING SHAFT	
RUN DATE	NOVEMBER 6, 1963	-NUMBER	1
DRIVE SHAFT		-RING CLEARANCE (INCH)	0.0064
-NUMBER	2	-PLENUM DEPTH (INCH)	0.1314
-DISCHARGE HOLE SIZE (INCH)	0.2500	FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE	
LOSS COEFFICIENT IS FOR CONTROL DRUM CLGVERLEAF (4.1 TO 5.1). AREA BASED ON (4) 0.1875 DIA HOLES.			

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	138.79	0.4666E-00	533.5	0.311E-01	36.52	0.5136E 05	0.1851E 01	0.510E-01
2	119.75	135.89	0.5894E 00	533.5	0.345E-01	36.41	0.5711E 05	0.1851E 01	0.579E-01
3	121.20	137.59	0.6631E 00	533.5	0.369E-01	35.55	0.6096E 05	0.1851E 01	0.610E-01
4	121.20	137.79	0.7859E 00	534.5	0.401E-01	35.95	0.6626E 05	0.1851E 01	0.664E-01
5	121.00	137.20	0.8596E 00	534.5	0.419E-01	35.20	0.6917E 05	0.1851E 01	0.695E-01
6	119.50	135.59	0.1007E 01	534.5	0.451E-01	35.79	0.7440E 05	0.1851E 01	0.757E-01
7	122.30	138.49	0.1071E 01	534.5	0.470E-01	35.47	0.7754E 05	0.1851E 01	0.773E-01
8	120.50	136.79	0.1203E 01	534.5	0.495E-01	35.72	0.8170E 05	0.1851E 01	0.824E-01
9	119.00	135.04	0.1336E 01	533.5	0.519E-01	35.87	0.8572E 05	0.1851E 01	0.874E-01
10	120.75	136.80	0.1400E 01	534.5	0.534E-01	35.61	0.8812E 05	0.1851E 01	0.889E-01
11	122.00	138.10	0.1474E 01	534.5	0.550E-01	35.45	0.9083E 05	0.1851E 01	0.908E-01
12	120.00	136.30	0.1546E 01	534.5	0.569E-01	35.49	0.9392E 05	0.1851E 01	0.951E-01
13	120.20	136.40	0.1719E 01	534.5	0.591E-01	35.76	0.9751E 05	0.1851E 01	0.987E-01
14	121.60	137.80	0.1733E 01	534.5	0.606E-01	35.68	0.1001E 06	0.1851E 01	0.100E-00
15	120.50	136.30	0.1916E 01	534.5	0.623E-01	35.77	0.1029E 06	0.1851E 01	0.104E-00
16	121.00	137.30	0.1930E 01	534.5	0.636E-01	35.58	0.1050E 06	0.1851E 01	0.106E-00
17	119.75	135.47	0.2112E 01	535.0	0.652E-01	35.45	0.1076E 06	0.1851E 01	0.110E-00
18	119.00	134.97	0.2210E 01	532.5	0.667E-01	35.39	0.1105E 06	0.1851E 01	0.112E-00
19	120.50	136.57	0.2284E 01	532.0	0.683E-01	35.45	0.1131E 06	0.1851E 01	0.114E-00
20	121.00	136.97	0.2318E 01	531.0	0.689E-01	35.06	0.1144E 06	0.1851E 01	0.114E-00
21	120.10	135.57	0.2407E 01	530.0	0.700E-01	34.89	0.1162E 06	0.1851E 01	0.117E-00
22	120.00	135.77	0.2554E 01	526.5	0.724E-01	35.31	0.1207E 06	0.1851E 01	0.121E-00
23	119.00	134.96	0.2800E 01	527.0	0.755E-01	35.51	0.1259E 06	0.1851E 01	0.127E-00
24	119.50	134.96	0.3119E 01	526.5	0.797E-01	35.60	0.1330E 06	0.1851E 01	0.134E-00
25	120.00	135.44	0.3448E 01	533.0	0.835E-01	35.90	0.1381E 06	0.1851E 01	0.140E-00
26	120.20	135.94	0.3659E 01	532.5	0.862E-01	35.54	0.1427E 06	0.1851E 01	0.144E-00
27	120.00	135.74	0.3915E 01	532.5	0.891E-01	35.46	0.1474E 06	0.1851E 01	0.149E-00
28	119.80	134.94	0.4249E 01	531.5	0.926E-01	35.66	0.1535E 06	0.1851E 01	0.156E-00
29	119.50	134.94	0.4671E 01	531.5	0.973E-01	36.36	0.1613E 06	0.1851E 01	0.164E-00
30	120.30	135.64	0.4951E 01	531.5	0.100E-00	36.40	0.1661E 06	0.1851E 01	0.168E-00
31	120.50	135.44	0.5772E 01	531.0	0.103E-00	36.60	0.1794E 06	0.1851E 01	0.181E-00
32	120.50	135.74	0.6248E 01	531.5	0.113E-00	36.65	0.1867E 06	0.1851E 01	0.189E-00
33	120.50	135.91	0.6705E 01	531.5	0.116E-00	36.70	0.1928E 06	0.1865E 01	0.194E-00
34	120.30	134.91	0.7172E 01	532.0	0.120E-00	36.76	0.1992E 06	0.1851E 01	0.203E-00
35	119.35	134.41	0.7589E 01	532.0	0.123E-00	36.78	0.2045E 06	0.1851E 01	0.209E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 LOSS COEFFICIENT IS FOR CONTROL DRUM CLOVERLEAF (4.1 TO 5.1). AREA BASED ON (4) 0.1875 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.96	0.4323E-00	533.0	0.307E-01	35.94	0.5074E 05	0.1736E 01	0.510E-01
2	120.75	137.36	0.5403E 00	531.5	0.344E-01	36.12	0.5703E 05	0.1736E 01	0.569E-01
3	120.50	136.87	0.6484E 00	531.5	0.376E-01	36.11	0.6236E 05	0.1736E 01	0.625E-01
4	120.20	136.37	0.7957E 00	531.5	0.416E-01	37.06	0.6896E 05	0.1736E 01	0.693E-01
5	121.20	137.57	0.8350E 00	531.5	0.428E-01	35.78	0.7095E 05	0.1736E 01	0.707E-01
6	121.00	137.07	0.9087E 00	531.5	0.444E-01	35.09	0.7363E 05	0.1747E 01	0.736E-01
7	120.75	136.87	0.1007E 01	530.0	0.468E-01	35.21	0.7745E 05	0.1736E 01	0.778E-01
8	121.75	137.96	0.1090E 01	533.0	0.489E-01	35.17	0.8089E 05	0.1736E 01	0.807E-01
9	120.80	136.96	0.1218E 01	533.0	0.515E-01	35.53	0.8521E 05	0.1736E 01	0.856E-01
10	120.75	135.82	0.1351E 01	535.0	0.539E-01	35.94	0.8896E 05	0.1736E 01	0.905E-01
11	120.50	136.82	0.1424E 01	536.5	0.555E-01	35.80	0.9139E 05	0.1736E 01	0.926E-01
12	120.20	136.42	0.1547E 01	536.5	0.578E-01	36.11	0.9524E 05	0.1736E 01	0.965E-01
13	121.50	138.32	0.1645E 01	536.5	0.600E-01	36.36	0.9876E 05	0.1736E 01	0.990E-01
14	120.60	136.82	0.1842E 01	536.0	0.631E-01	37.19	0.1040E 06	0.1736E 01	0.105E-00
15	121.00	137.32	0.1906E 01	536.0	0.643E-01	36.92	0.1060E 06	0.1736E 01	0.107E-00
16	121.00	137.52	0.2014E 01	537.5	0.661E-01	37.08	0.1087E 06	0.1736E 01	0.110E-00
17	120.75	136.49	0.2180E 01	533.0	0.689E-01	36.81	0.1140E 06	0.1736E 01	0.115E-00
18	121.30	137.04	0.2333E 01	531.5	0.714E-01	36.59	0.1184E 06	0.1736E 01	0.118E-00
19	120.60	136.49	0.2603E 01	531.0	0.753E-01	37.16	0.1249E 06	0.1736E 01	0.125E-00
20	120.60	136.39	0.2874E 01	531.0	0.791E-01	37.38	0.1312E 06	0.1736E 01	0.132E-00
21	119.85	135.29	0.3483E 01	531.0	0.868E-01	37.46	0.1439E 06	0.1736E 01	0.146E-00
22	120.75	135.99	0.5153E 01	531.0	0.106E-00	37.64	0.1755E 06	0.1736E 01	0.177E-00
23	120.00	134.79	0.6150E 01	530.0	0.115E-00	37.62	0.1912E 06	0.1736E 01	0.194E-00
24	120.00	134.39	0.7122E 01	530.5	0.124E-00	37.76	0.2053E 06	0.1736E 01	0.209E-00

WANT-TME-715

04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR CONTROL DRUM CLOVERLEAF (4.1 TO 5.1). AREA BASED ON (4) 0.1875 DIA HOLES.

	PL PSIG	PXA PSIA	DELPXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	134.22	0.4519E-00	535.5	0.314E-01	36.78	0.5170E 05	0.1695E 01	0.533E-01
2	119.00	135.51	0.5403E 00	537.5	0.344E-01	36.49	0.5655E 05	0.1695E 01	0.580E-01
3	120.50	136.71	0.6306E 00	538.0	0.375E-01	36.45	0.6168E 05	0.1695E 01	0.628E-01
4	120.50	136.71	0.7369E 00	538.0	0.403E-01	36.36	0.6625E 05	0.1695E 01	0.674E-01
5	121.50	137.61	0.8350E 00	537.0	0.431E-01	36.41	0.7092E 05	0.1695E 01	0.715E-01
6	121.30	137.21	0.9480E 00	538.0	0.458E-01	36.60	0.7529E 05	0.1695E 01	0.763E-01
7	120.60	136.71	0.1032E 01	536.5	0.473E-01	36.26	0.7865E 05	0.1695E 01	0.798E-01
8	121.20	137.92	0.1130E 01	537.5	0.502E-01	36.41	0.8250E 05	0.1695E 01	0.831E-01
9	120.30	136.22	0.1233E 01	537.5	0.525E-01	36.55	0.8633E 05	0.1695E 01	0.881E-01
10	120.50	136.22	0.1331E 01	536.0	0.542E-01	36.31	0.8929E 05	0.1695E 01	0.908E-01
11	121.10	136.85	0.1253E 01	536.0	0.527E-01	36.61	0.8682E 05	0.1695E 01	0.878E-01
12	121.00	136.85	0.1336E 01	536.0	0.544E-01	36.43	0.8966E 05	0.1695E 01	0.907E-01
13	120.75	136.85	0.1424E 01	536.0	0.562E-01	36.33	0.9258E 05	0.1695E 01	0.937E-01
14	120.00	135.76	0.1523E 01	535.5	0.579E-01	36.21	0.9545E 05	0.1695E 01	0.972E-01
15	120.70	136.76	0.1695E 01	535.5	0.613E-01	37.19	0.1011E 06	0.1695E 01	0.102E-00
16	121.20	136.96	0.1793E 01	535.5	0.631E-01	37.25	0.1040E 06	0.1695E 01	0.105E-00
17	120.00	136.11	0.1817E 01	526.0	0.639E-01	36.27	0.1067E 06	0.1695E 01	0.106E-00
18	120.50	136.36	0.1867E 01	524.0	0.649E-01	35.92	0.1087E 06	0.1695E 01	0.107E-00
19	120.75	136.85	0.2014E 01	524.0	0.676E-01	35.72	0.1131E 06	0.1695E 01	0.111E-00
20	120.75	136.35	0.2210E 01	524.5	0.706E-01	35.89	0.1181E 06	0.1695E 01	0.117E-00
21	120.00	135.55	0.2407E 01	524.5	0.735E-01	35.96	0.1229E 06	0.1695E 01	0.122E-00
22	121.20	136.85	0.2579E 01	523.0	0.765E-01	36.02	0.1283E 06	0.1695E 01	0.126E-00
23	119.50	134.35	0.3836E 01	522.5	0.928E-01	36.61	0.1556E 06	0.1695E 01	0.156E-00
24	120.10	134.84	0.4838E 01	526.0	0.104E-00	36.75	0.1732E 06	0.1695E 01	0.174E-00
25	119.90	134.34	0.5845E 01	525.0	0.114E-00	37.08	0.1905E 06	0.1695E 01	0.192E-00
26	120.60	134.74	0.6729E 01	525.0	0.122E-00	37.30	0.2047E 06	0.1695E 01	0.205E-00
27	120.00	134.64	0.5379E 01	525.0	0.109E-00	37.03	0.1829E 06	0.1695E 01	0.184E-00
28	120.00	134.34	0.5729E 01	524.0	0.122E-00	38.39	0.2048E 06	0.1695E 01	0.206E-00

UNIT-TIME-715

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR CONTROL DRUM CLOVERLEAF (4.1 TO 5.1). AREA BASED ON (4) 0.1875 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.87	0.4421E-00	528.5	0.323E-01	37.68	0.5367E 05	0.1619E 01	0.534E-01
2	121.00	137.31	0.5403E 00	531.5	0.356E-01	37.44	0.5905E 05	0.1619E 01	0.590E-01
3	120.30	136.61	0.6631E 00	528.0	0.395E-01	37.86	0.6576E 05	0.1619E 01	0.655E-01
4	120.30	136.61	0.7014E 00	527.0	0.424E-01	37.42	0.7062E 05	0.1619E 01	0.702E-01
5	121.50	138.01	0.8596E 00	527.0	0.452E-01	37.71	0.7542E 05	0.1619E 01	0.742E-01
6	121.20	137.51	0.9578E 00	527.0	0.477E-01	37.55	0.7947E 05	0.1619E 01	0.784E-01
7	121.00	137.31	0.1012E 01	527.0	0.490E-01	36.69	0.8162E 05	0.1619E 01	0.807E-01
8	121.30	137.51	0.1130E 01	527.0	0.518E-01	37.09	0.8631E 05	0.1619E 01	0.852E-01
9	120.30	136.54	0.1253E 01	531.5	0.541E-01	37.30	0.8965E 05	0.1619E 01	0.900E-01
10	121.00	137.09	0.1320E 01	529.5	0.559E-01	37.05	0.9285E 05	0.1619E 01	0.924E-01
11	120.60	136.84	0.1400E 01	528.5	0.574E-01	36.73	0.9552E 05	0.1619E 01	0.951E-01
12	121.00	136.85	0.1523E 01	527.5	0.599E-01	37.09	0.9985E 05	0.1619E 01	0.991E-01
13	121.00	136.85	0.1596E 01	527.0	0.614E-01	36.87	0.1024E 06	0.1619E 01	0.102E-00
14	121.10	137.05	0.1631E 01	527.0	0.621E-01	36.25	0.1035E 06	0.1619E 01	0.103E-00
15	121.50	137.65	0.1729E 01	526.0	0.641E-01	36.45	0.1071E 06	0.1619E 01	0.105E-00
16	121.50	137.55	0.1793E 01	526.0	0.653E-01	36.20	0.1090E 06	0.1619E 01	0.107E-00
17	120.00	135.66	0.2210E 01	528.0	0.719E-01	38.13	0.1196E 06	0.1619E 01	0.120E-00
18	120.50	136.36	0.2137E 01	527.5	0.709E-01	36.06	0.1181E 06	0.1619E 01	0.118E-00
19	120.10	136.26	0.2382E 01	527.5	0.748E-01	36.69	0.1246E 06	0.1619E 01	0.124E-00
20	121.10	136.93	0.2775E 01	525.5	0.811E-01	38.18	0.1354E 06	0.1619E 01	0.134E-00
21	121.50	136.93	0.3488E 01	524.5	0.910E-01	36.00	0.1522E 06	0.1619E 01	0.150E-00
22	121.00	136.33	0.4323E 01	524.5	0.101E-00	35.62	0.1691E 06	0.1619E 01	0.167E-00
23	120.75	135.43	0.5280E 01	523.5	0.111E-00	36.09	0.1867E 06	0.1619E 01	0.186E-00
24	120.50	135.10	0.6214E 01	523.5	0.121E-00	36.61	0.2023E 06	0.1619E 01	0.201E-00
25	120.70	135.63	0.5059E 01	524.0	0.109E-00	36.77	0.1826E 06	0.1619E 01	0.182E-00
26	120.00	134.93	0.6115E 01	524.0	0.120E-00	37.45	0.2003E 06	0.1619E 01	0.200E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
 RUN DATE NOVEMBER 6, 1963

NOZZLE END BEARING SHAFT

-NUMBER 1
 -RING CLEARANCE (INCH) 0.0064
 -PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT

-NUMBER 2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 4.1 TO 7.1 AREA BASED ON (4) 0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPA PSIG	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	138.79	0.1030E 01	533.5	0.311E-01	36.52	0.5352E 05	0.3671E 01	0.553E-01
2	119.75	135.89	0.1375E 01	533.5	0.345E-01	36.41	0.5952E 05	0.3665E 01	0.628E-01
3	121.20	137.59	0.1670E 01	533.5	0.369E-01	35.55	0.6352E 05	0.3956E 01	0.662E-01
4	121.20	137.79	0.1916E 01	534.5	0.401E-01	35.95	0.6905E 05	0.3829E 01	0.720E-01
5	121.00	137.29	0.2235E 01	534.5	0.419E-01	35.20	0.7209E 05	0.4084E 01	0.755E-01
6	119.50	135.59	0.2530E 01	534.5	0.451E-01	35.79	0.7754E 05	0.3946E 01	0.822E-01
7	122.30	138.49	0.2770E 01	534.5	0.470E-01	35.47	0.8081E 05	0.4064E 01	0.839E-01
8	120.50	136.79	0.3045E 01	534.5	0.495E-01	35.72	0.8514E 05	0.3975E 01	0.895E-01
9	119.00	135.04	0.3316E 01	533.5	0.519E-01	35.87	0.8933E 05	0.3898E 01	0.949E-01
10	120.75	136.80	0.3512E 01	534.5	0.534E-01	35.61	0.9183E 05	0.3941E 01	0.965E-01
11	122.00	138.10	0.3753E 01	534.5	0.550E-01	35.45	0.9466E 05	0.4006E 01	0.985E-01
12	120.00	136.30	0.4120E 01	534.5	0.569E-01	35.49	0.9788E 05	0.4060E 01	0.103E-00
13	120.20	136.40	0.4421E 01	534.5	0.591E-01	35.76	0.1016E 06	0.4039E 01	0.107E-00
14	121.60	137.80	0.4606E 01	534.5	0.606E-01	35.68	0.1043E 06	0.4088E 01	0.109E-00
15	120.50	136.30	0.5017E 01	534.5	0.623E-01	35.77	0.1072E 06	0.4108E 01	0.113E-00
16	121.00	137.30	0.5207E 01	534.5	0.636E-01	35.58	0.1094E 06	0.4132E 01	0.115E-00
17	119.75	135.47	0.5426E 01	535.0	0.652E-01	35.45	0.1121E 06	0.4037E 01	0.119E-00
18	119.00	134.97	0.5640E 01	532.5	0.667E-01	35.39	0.1151E 06	0.4014E 01	0.122E-00
19	120.50	136.57	0.5944E 01	532.0	0.683E-01	35.45	0.1178E 06	0.4088E 01	0.123E-00
20	121.00	136.97	0.6066E 01	531.0	0.689E-01	35.06	0.1192E 06	0.4110E 01	0.124E-00
21	120.10	135.57	0.6165E 01	530.0	0.700E-01	34.89	0.1211E 06	0.4023E 01	0.127E-00
22	120.00	135.77	0.6607E 01	526.5	0.724E-01	35.31	0.1258E 06	0.4063E 01	0.131E-00
23	119.00	134.36	0.7034E 01	527.0	0.755E-01	35.51	0.1312E 06	0.3946E 01	0.137E-00
24	119.50	134.96	0.7663E 01	526.5	0.797E-01	35.60	0.1386E 06	0.3859E 01	0.145E-00
25	120.00	135.44	0.7957E 01	533.0	0.835E-01	35.90	0.1439E 06	0.3625E 01	0.152E-00
26	120.20	135.94	0.9431E 01	532.5	0.862E-01	35.54	0.1487E 06	0.4048E 01	0.157E-00
27	120.00	135.74	0.1005E 02	532.5	0.891E-01	35.46	0.1536E 06	0.4031E 01	0.162E-00
28	119.80	134.94	0.1036E 02	531.5	0.926E-01	35.66	0.1600E 06	0.3832E 01	0.169E-00
29	117.50	134.94	0.1039E 02	531.5	0.973E-01	36.36	0.1681E 06	0.3479E 01	0.178E-00
30	120.30	135.64	0.1132E 02	531.5	0.100E-00	36.40	0.1731E 06	0.3592E 01	0.182E-00
31	120.50	135.44	0.1312E 02	531.0	0.108E-00	36.60	0.1870E 06	0.3569E 01	0.197E-00
32	120.50	135.74	0.1388E 02	531.5	0.113E-00	36.65	0.1945E 06	0.3489E 01	0.205E-00
33	120.50	135.91	0.1506E 02	531.5	0.117E-00	35.84	0.2017E 06	0.3527E 01	0.212E-00
34	120.30	134.91	0.1621E 02	532.0	0.120E-00	36.76	0.2076E 06	0.3550E 01	0.220E-00
35	119.85	134.41	0.1712E 02	532.0	0.123E-00	36.78	0.2131E 06	0.3543E 01	0.227E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT

-NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 4.1 TO 7.1 AREA BASED ON (4) 0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLUX LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.86	0.1105E 01	533.0	0.307E-01	35.94	0.5288E 05	0.3766E 01	0.554E-01
2	120.75	137.36	0.1351E 01	531.5	0.344E-01	36.12	0.5943E 05	0.3683E 01	0.618E-01
3	120.50	136.87	0.1621E 01	531.5	0.376E-01	36.11	0.6498E 05	0.3683E 01	0.678E-01
4	120.20	136.37	0.1926E 01	531.5	0.416E-01	37.06	0.7186E 05	0.3564E 01	0.753E-01
5	121.20	137.57	0.2210E 01	531.5	0.428E-01	35.78	0.7394E 05	0.3899E 01	0.768E-01
6	121.00	137.07	0.2505E 01	531.5	0.446E-01	35.20	0.7699E 05	0.4061E 01	0.802E-01
7	120.75	136.87	0.2800E 01	533.0	0.468E-01	35.21	0.8071E 05	0.4096E 01	0.845E-01
8	121.75	137.86	0.3095E 01	533.0	0.489E-01	35.17	0.8430E 05	0.4180E 01	0.876E-01
9	120.80	136.96	0.3340E 01	533.0	0.515E-01	35.58	0.8880E 05	0.4039E 01	0.929E-01
10	120.75	135.82	0.3488E 01	535.0	0.539E-01	35.94	0.9271E 05	0.3803E 01	0.982E-01
11	120.50	136.82	0.4052E 01	536.5	0.555E-01	35.80	0.9524E 05	0.4191E 01	0.101E-00
12	120.20	136.82	0.4617E 01	536.5	0.578E-01	36.11	0.9926E 05	0.4396E 01	0.105E-00
13	121.50	138.32	0.4838E 01	536.5	0.600E-01	36.36	0.1029E 06	0.4331E 01	0.107E-00
14	120.60	136.82	0.5059E 01	536.0	0.631E-01	37.19	0.1084E 06	0.4046E 01	0.114E-00
15	121.00	137.32	0.5010E 01	536.0	0.643E-01	36.92	0.1105E 06	0.3872E 01	0.116E-00
16	121.00	137.52	0.5747E 01	537.5	0.661E-01	37.08	0.1133E 06	0.4204E 01	0.119E-00
17	120.75	136.49	0.5944E 01	533.0	0.689E-01	36.81	0.1188E 06	0.4005E 01	0.125E-00
18	121.30	137.04	0.6920E 01	531.5	0.714E-01	36.59	0.1234E 06	0.4373E 01	0.129E-00
19	120.60	136.49	0.7400E 01	531.0	0.753E-01	37.16	0.1302E 06	0.4225E 01	0.136E-00
20	120.60	136.39	0.8055E 01	531.0	0.791E-01	37.38	0.1367E 06	0.4130E 01	0.143E-00
21	119.85	135.29	0.1022E 02	531.0	0.868E-01	37.46	0.1500E 06	0.4315E 01	0.158E-00
22	120.75	135.99	0.1523E 02	531.0	0.106E-00	37.64	0.1829E 06	0.4363E 01	0.192E-00
23	120.00	134.77	0.1807E 02	530.0	0.115E-00	37.62	0.1993E 06	0.4471E 01	0.210E-00
24	120.00	134.39	0.2157E 02	530.5	0.124E-00	37.76	0.2139E 06	0.4419E 01	0.227E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT

-NUMBER 3
-RING CLEARANCE (INCH) 0.1264
-PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT

-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 4.1 TO 7.1 AREA BASED ON (4) 0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DEL PX PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	134.22	0.1091E 02	535.5	0.314E-01	36.78	0.5388E 05	0.3475E 02	0.578E-01
2	118.00	135.51	0.1375E 01	537.5	0.344E-01	36.49	0.5893E 05	0.3662E 01	0.629E-01
3	120.50	136.71	0.1582E 01	538.0	0.375E-01	36.45	0.6428E 05	0.3564E 01	0.681E-01
4	120.50	136.71	0.1857E 01	538.0	0.403E-01	36.36	0.6905E 05	0.3626E 01	0.732E-01
5	121.50	137.61	0.2063E 01	537.0	0.431E-01	36.41	0.7391E 05	0.3555E 01	0.777E-01
6	121.30	137.21	0.2456E 01	538.0	0.458E-01	36.60	0.7846E 05	0.3727E 01	0.829E-01
7	120.60	136.71	0.2726E 01	536.5	0.478E-01	36.26	0.8197E 05	0.3802E 01	0.866E-01
8	121.90	137.92	0.2937E 01	537.5	0.502E-01	36.41	0.8597E 05	0.3741E 01	0.902E-01
9	120.30	136.22	0.3365E 01	537.5	0.525E-01	36.55	0.8996E 05	0.3865E 01	0.956E-01
10	120.50	136.22	0.3546E 01	536.0	0.542E-01	36.31	0.9305E 05	0.3833E 01	0.985E-01
11	121.10	136.85	0.3266E 01	536.0	0.527E-01	36.61	0.9047E 05	0.3752E 01	0.954E-01
12	121.00	136.85	0.3596E 01	536.0	0.544E-01	36.43	0.9344E 05	0.3872E 01	0.985E-01
13	120.75	136.85	0.3979E 01	536.0	0.562E-01	36.33	0.9648E 05	0.4019E 01	0.102E-00
14	120.00	135.76	0.4028E 01	535.5	0.579E-01	36.21	0.9947E 05	0.3806E 01	0.106E-00
15	120.70	136.76	0.4470E 01	535.5	0.613E-01	37.19	0.1053E 06	0.3795E 01	0.111E-00
16	121.20	136.96	0.4765E 01	535.5	0.631E-01	37.25	0.1084E 06	0.3823E 01	0.114E-00
17	120.00	136.11	0.5084E 01	526.0	0.639E-01	36.27	0.1112E 06	0.4025E 01	0.115E-00
18	120.50	136.36	0.5575E 01	524.0	0.649E-01	35.92	0.1133E 06	0.4297E 01	0.117E-00
19	120.75	136.85	0.5894E 01	524.0	0.676E-01	35.72	0.1179E 06	0.4211E 01	0.121E-00
20	120.75	136.35	0.6828E 01	524.5	0.706E-01	35.89	0.1231E 06	0.4444E 01	0.127E-00
21	120.00	135.55	0.7614E 01	524.5	0.735E-01	35.96	0.1281E 06	0.4551E 01	0.133E-00
22	121.20	136.85	0.8056E 01	523.0	0.765E-01	36.02	0.1337E 06	0.4494E 01	0.137E-00
23	119.50	134.35	0.1206E 02	522.5	0.928E-01	36.61	0.1621E 06	0.4499E 01	0.169E-00
24	120.10	134.84	0.1307E 02	526.0	0.104E-00	36.75	0.1805E 06	0.3885E 01	0.189E-00
25	119.90	134.34	0.1763E 02	525.0	0.114E-00	37.08	0.1985E 06	0.4340E 01	0.208E-00
26	120.60	134.74	0.2097E 02	525.0	0.122E-00	37.30	0.2133E 06	0.4484E 01	0.223E-00
27	120.00	134.64	0.1650E 02	525.0	0.109E-00	37.03	0.1906E 06	0.4415E 01	0.199E-00
28	120.00	134.34	0.2041E 02	524.0	0.122E-00	38.39	0.2135E 06	0.4363E 01	0.223E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE AND BEARING SHAFT
 -NUMBER
 -RING CLEARANCE (INCH)
 -PLENUM DEPTH (INCH)

4
 0.2035
 0.3285

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 4.1 TO 7.1. AREA BASED ON (4) 0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLCW LB/SEC	PRCTW	PEYN	COEFPL	MACH
1	120.50	136.82	0.1061E 01	528.5	0.323E-01	37.62	0.5593E 05	0.3297E 01	0.580E-01
2	121.00	137.31	0.1302E 01	531.5	0.356E-01	37.44	0.6153E 05	0.3309E 01	0.640E-01
3	120.30	136.61	0.1532E 01	528.0	0.395E-01	37.86	0.6853E 05	0.3276E 01	0.711E-01
4	120.30	136.61	0.1317E 01	527.0	0.424E-01	37.42	0.7360E 05	0.3279E 01	0.762E-01
5	121.50	138.01	0.2063E 01	527.0	0.452E-01	37.71	0.7860E 05	0.3297E 01	0.805E-01
6	121.20	137.51	0.2307E 01	527.0	0.477E-01	37.55	0.8282E 05	0.3311E 01	0.851E-01
7	121.00	137.31	0.2603E 01	527.0	0.490E-01	36.69	0.8506E 05	0.3534E 01	0.876E-01
8	121.30	137.51	0.2307E 01	527.0	0.518E-01	37.09	0.8995E 05	0.3404E 01	0.925E-01
9	120.30	136.54	0.3021E 01	531.5	0.541E-01	37.30	0.9342E 05	0.3313E 01	0.977E-01
10	121.00	137.00	0.3271E 01	529.5	0.559E-01	37.00	0.9676E 05	0.3409E 01	0.100E-00
11	120.60	136.84	0.3546E 01	528.5	0.574E-01	36.73	0.9954E 05	0.3480E 01	0.103E-00
12	121.00	136.85	0.3389E 01	527.5	0.599E-01	37.09	0.1041E 06	0.3500E 01	0.108E-00
13	121.00	136.85	0.4277E 01	527.0	0.614E-01	36.87	0.1067E 06	0.3677E 01	0.110E-00
14	121.10	137.05	0.4617E 01	527.0	0.621E-01	36.25	0.1079E 06	0.3889E 01	0.111E-00
15	121.50	137.65	0.4937E 01	526.0	0.641E-01	36.45	0.1116E 06	0.3922E 01	0.114E-00
16	121.50	137.55	0.5330E 01	526.0	0.653E-01	36.20	0.1136E 06	0.4083E 01	0.116E-00
17	120.00	135.66	0.4937E 01	528.0	0.719E-01	38.13	0.1247E 06	0.3068E 01	0.130E-00
18	120.50	136.55	0.6091E 01	527.5	0.709E-01	36.06	0.1230E 06	0.3916E 01	0.128E-00
19	120.10	136.26	0.7172E 01	527.5	0.748E-01	36.69	0.1299E 06	0.4135E 01	0.135E-00
20	121.10	136.93	0.6091E 01	525.5	0.811E-01	38.18	0.1412E 06	0.3015E 01	0.145E-00
21	121.50	136.93	0.1036E 02	524.5	0.910E-01	36.00	0.1586E 06	0.4082E 01	0.163E-00
22	121.00	136.33	0.1459E 02	524.5	0.101E-00	35.62	0.1762E 06	0.4636E 01	0.182E-00
23	120.75	135.43	0.1714E 02	523.5	0.111E-00	36.09	0.1945E 06	0.4459E 01	0.201E-00
24	120.50	135.18	0.1980E 02	523.5	0.121E-00	36.61	0.2108E 06	0.4376E 01	0.219E-00
25	120.75	135.63	0.1589E 02	524.0	0.109E-00	36.77	0.1903E 06	0.4314E 01	0.197E-00
26	120.00	134.93	0.1903E 02	524.0	0.120E-00	37.45	0.2087E 06	0.4275E 01	0.217E-00

WALT-THF-715

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14 RUN DATE NOVEMBER 6, 1963 DRIVE SHAFT - NUMBER 2 - DISCHARGE HOLE SIZE (INCH) 0.2500	NOZZLE END BEARING SHAFT - NUMBER 1 - RING CLEARANCE (INCH) 0.0064 - PLENUM DEPTH (INCH) 0.1314 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 5.1 TO 7.1. AREA BASED ON (4) 0.180 DIA
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	P1 PSIG	PXA PSIA	DEL PXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	137.04	0.6779E 00	533.5	0.311E-01	36.52	0.5352E 05	0.2253E 01	0.560E-01
2	119.75	134.24	0.9449E 00	533.5	0.345E-01	36.41	0.5952E 05	0.2224E 01	0.636E-01
3	121.20	135.49	0.1007E 01	533.5	0.369E-01	35.55	0.6352E 05	0.2349E 01	0.673E-01
4	121.20	135.79	0.1179E 01	534.5	0.401E-01	35.95	0.6905E 05	0.2322E 01	0.731E-01
5	121.00	135.04	0.1375E 01	534.5	0.419E-01	35.20	0.7209E 05	0.2472E 01	0.767E-01
6	119.50	133.49	0.1444E 01	534.5	0.451E-01	35.79	0.7754E 05	0.2301E 01	0.835E-01
7	122.30	136.29	0.1719E 01	534.5	0.470E-01	35.47	0.8081E 05	0.2482E 01	0.852E-01
8	120.50	134.79	0.1916E 01	534.5	0.495E-01	35.72	0.8514E 05	0.2464E 01	0.908E-01
9	119.00	132.79	0.1965E 01	533.5	0.519E-01	35.87	0.8933E 05	0.2272E 01	0.965E-01
10	120.75	134.50	0.2166E 01	534.5	0.534E-01	35.61	0.9183E 05	0.2411E 01	0.982E-01
11	122.00	135.30	0.2333E 01	534.5	0.550E-01	35.45	0.9466E 05	0.2437E 01	0.101E-00
12	120.00	133.60	0.2652E 01	534.5	0.569E-01	35.49	0.9788E 05	0.2558E 01	0.105E-00
13	120.20	133.80	0.2775E 01	534.5	0.591E-01	35.76	0.1016E 06	0.2487E 01	0.109E-00
14	121.60	134.80	0.2751E 01	534.5	0.606E-01	35.68	0.1043E 06	0.2358E 01	0.111E-00
15	120.50	133.40	0.3045E 01	534.5	0.623E-01	35.77	0.1072E 06	0.2444E 01	0.116E-00
16	121.00	134.10	0.3291E 01	534.5	0.636E-01	35.58	0.1094E 06	0.2551E 01	0.117E-00
17	119.75	132.27	0.3271E 01	535.0	0.652E-01	35.45	0.1121E 06	0.2390E 01	0.122E-00
18	119.00	131.47	0.3468E 01	532.5	0.667E-01	35.39	0.1151E 06	0.2414E 01	0.125E-00
19	120.50	132.97	0.3497E 01	532.0	0.683E-01	35.45	0.1178E 06	0.2342E 01	0.127E-00
20	121.00	133.22	0.3684E 01	531.0	0.689E-01	35.06	0.1192E 06	0.2428E 01	0.128E-00
21	120.10	131.97	0.3930E 01	530.0	0.700E-01	34.89	0.1211E 06	0.2497E 01	0.131E-00
22	120.00	131.97	0.3979E 01	526.5	0.724E-01	35.31	0.1258E 06	0.2378E 01	0.135E-00
23	119.00	130.86	0.4273E 01	527.0	0.755E-01	35.51	0.1312E 06	0.2325E 01	0.142E-00
24	119.50	130.86	0.4986E 01	526.5	0.797E-01	35.60	0.1386E 06	0.2435E 01	0.150E-00
25	120.00	130.94	0.4606E 01	533.0	0.835E-01	35.90	0.1439E 06	0.2055E 01	0.157E-00
26	120.20	130.94	0.5747E 01	532.5	0.862E-01	35.54	0.1487E 06	0.2376E 01	0.162E-00
27	120.00	130.64	0.6091E 01	532.5	0.891E-01	35.46	0.1536E 06	0.2352E 01	0.168E-00
28	119.80	129.64	0.6140E 01	531.5	0.926E-01	35.66	0.1600E 06	0.2181E 01	0.176E-00
29	119.50	128.94	0.5821E 01	531.5	0.973E-01	36.36	0.1681E 06	0.1862E 01	0.186E-00
30	120.30	129.44	0.6386E 01	531.5	0.100E-00	36.40	0.1731E 06	0.1933E 01	0.191E-00
31	120.50	128.84	0.7313E 01	531.0	0.108E-00	36.60	0.1870E 06	0.1895E 01	0.207E-00
32	120.50	128.44	0.7663E 01	531.5	0.113E-00	36.65	0.1945E 06	0.1823E 01	0.216E-00
33	120.50	127.94	0.8350E 01	531.5	0.117E-00	36.79	0.2017E 06	0.1841E 01	0.225E-00
34	120.30	126.84	0.9063E 01	532.0	0.120E-00	36.72	0.2076E 06	0.1866E 01	0.234E-00
35	119.55	125.41	0.9824E 01	532.0	0.123E-00	36.78	0.2131E 06	0.1897E 01	0.243E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
 RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT

-NUMBER 2
 -RING CLEARANCE (INCH) 0.0498
 -PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE POLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 5.1 TO 7.1. AREA BASED ON (4) 0.180 DIA

	PI PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	135.36	0.6877E 00	533.0	0.307E-01	35.94	0.5288E 05	0.2318E 01	0.560E-01
2	120.75	135.36	0.8105E 00	531.5	0.344E-01	36.12	0.5943E 05	0.2177E 01	0.627E-01
3	120.50	134.87	0.9726E 00	531.5	0.376E-01	36.11	0.6498E 05	0.2177E 01	0.688E-01
4	120.20	134.47	0.1179E 01	531.5	0.416E-01	37.06	0.7186E 05	0.2152E 01	0.763E-01
5	121.20	135.37	0.1400E 01	531.5	0.428E-01	35.78	0.7394E 05	0.2430E 01	0.780E-01
6	121.00	135.17	0.1621E 01	531.5	0.446E-01	35.20	0.7699E 05	0.2590E 01	0.814E-01
7	120.75	134.87	0.1719E 01	533.0	0.468E-01	35.21	0.8071E 05	0.2478E 01	0.858E-01
8	121.75	135.36	0.1959E 01	533.0	0.489E-01	35.17	0.8430E 05	0.2639E 01	0.892E-01
9	120.80	134.36	0.2161E 01	533.0	0.515E-01	35.58	0.8880E 05	0.2564E 01	0.947E-01
10	120.75	133.62	0.2137E 01	535.0	0.539E-01	35.94	0.9271E 05	0.2292E 01	0.999E-01
11	120.50	134.32	0.2702E 01	536.5	0.555E-01	35.80	0.9524E 05	0.2743E 01	0.102E-00
12	120.20	134.32	0.2374E 01	536.5	0.578E-01	36.11	0.9926E 05	0.2686E 01	0.107E-00
13	121.50	135.52	0.2972E 01	536.5	0.600E-01	36.36	0.1029E 06	0.2606E 01	0.110E-00
14	120.60	134.22	0.3355E 01	536.0	0.631E-01	37.19	0.1084E 06	0.2640E 01	0.117E-00
15	121.00	134.52	0.3610E 01	536.0	0.643E-01	36.92	0.1105E 06	0.2734E 01	0.118E-00
16	121.00	134.32	0.3782E 01	537.5	0.661E-01	37.08	0.1133E 06	0.2702E 01	0.122E-00
17	120.75	133.49	0.4003E 01	533.0	0.687E-01	36.81	0.1188E 06	0.2639E 01	0.127E-00
18	121.30	134.04	0.4503E 01	531.5	0.714E-01	36.59	0.1234E 06	0.2836E 01	0.131E-00
19	120.60	132.79	0.4906E 01	531.0	0.753E-01	37.16	0.1302E 06	0.2745E 01	0.140E-00
20	120.60	132.50	0.4912E 01	531.0	0.791E-01	37.38	0.1367E 06	0.2448E 01	0.147E-00
21	119.85	130.79	0.6631E 01	531.0	0.868E-01	37.46	0.1500E 06	0.2708E 01	0.164E-00
22	120.75	129.79	0.9947E 01	531.0	0.106E-00	37.64	0.1829E 06	0.2711E 01	0.201E-00
23	120.00	127.69	0.1243E 02	530.0	0.115E-00	37.62	0.1993E 06	0.2820E 01	0.222E-00
24	120.00	126.29	0.1459E 02	530.5	0.124E-00	37.76	0.2139E 06	0.2835E 01	0.241E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 -PLENUM DEPTH (INCH) 0.2514

DRIVE SHAFT
 -DISCHARGE HOLE SIZE (INCH) 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 5.1 TO 7.1. AREA BASED ON (4) 0.180 DIA

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PPCTW	REYN	COEFPL	MACH
1	119.50	132.72	0.6631E 00	535.5	0.314E-01	36.78	0.5388E 05	0.2088E 01	0.585E-01
2	118.00	134.21	0.8449E 00	537.5	0.344E-01	36.49	0.5893E 05	0.2228E 01	0.636E-01
3	120.50	134.96	0.9824E 00	538.0	0.375E-01	36.45	0.6428E 05	0.2185E 01	0.690E-01
4	120.50	134.81	0.1140E 01	538.0	0.403E-01	36.36	0.6905E 05	0.2194E 01	0.742E-01
5	121.5	135.31	0.1302E 01	537.0	0.431E-01	36.41	0.7391E 05	0.2205E 01	0.790E-01
6	121.30	135.21	0.1478E 01	538.0	0.458E-01	36.60	0.7846E 05	0.2241E 01	0.841E-01
7	120.6	136.61	0.1670E 01	536.5	0.478E-01	36.26	0.8197E 05	0.2328E 01	0.867E-01
8	121.90	135.42	0.1842E 01	537.5	0.502E-01	36.41	0.8597E 05	0.2303E 01	0.919E-01
9	120.30	134.12	0.2063E 01	537.5	0.525E-01	36.55	0.8996E 05	0.2333E 01	0.971E-01
10	120.50	134.22	0.2260E 01	536.0	0.542E-01	36.31	0.9305E 05	0.2406E 01	0.100E-00
11	121.10	134.75	0.2014E 01	536.0	0.527E-01	36.61	0.9047E 05	0.2278E 01	0.968E-01
12	121.00	134.55	0.2260E 01	536.0	0.544E-01	36.43	0.9344E 05	0.2392E 01	0.100E-00
13	120.75	134.55	0.2481E 01	536.0	0.562E-01	36.33	0.9648E 05	0.2463E 01	0.103E-00
14	120.00	133.01	0.2603E 01	535.5	0.579E-01	36.21	0.9947E 05	0.2410E 01	0.108E-00
15	120.70	134.26	0.2824E 01	535.5	0.613E-01	37.19	0.1053E 06	0.2354E 01	0.113E-00
16	121.20	134.25	0.3070E 01	535.5	0.631E-01	37.25	0.1084E 06	0.2415E 01	0.116E-00
17	120.00	133.15	0.3389E 01	526.0	0.639E-01	36.27	0.1112E 06	0.2625E 01	0.118E-00
18	120.50	133.56	0.3684E 01	524.0	0.647E-01	35.92	0.1133E 06	0.2781E 01	0.119E-00
19	120.75	133.85	0.3855E 01	524.0	0.676E-01	35.77	0.1179E 06	0.2694E 01	0.124E-00
20	120.75	133.35	0.4593E 01	524.5	0.706E-01	35.89	0.1231E 06	0.2924E 01	0.130E-00
21	120.00	132.05	0.5103E 01	524.5	0.735E-01	35.96	0.1281E 06	0.2975E 01	0.136E-00
22	121.20	133.25	0.5330E 01	523.0	0.765E-01	36.02	0.1337E 06	0.2897E 01	0.140E-00
23	119.50	124.35	0.8252E 01	522.5	0.928E-01	36.61	0.1621E 06	0.2964E 01	0.175E-00
24	120.10	127.09	0.8443E 01	526.0	0.104E-00	36.75	0.1805E 06	0.2405E 01	0.197E-00
25	119.30	127.34	0.1114E 02	525.0	0.114E-00	37.03	0.1985E 06	0.2785E 01	0.219E-00
26	120.60	126.84	0.1405E 02	525.0	0.122E-00	37.30	0.2133E 06	0.2827E 01	0.237E-00
27	120.00	127.84	0.1105E 02	525.0	0.109E-00	37.03	0.1906E 06	0.2807E 01	0.210E-00
28	120.00	126.94	0.1351E 02	524.0	0.122E-00	38.39	0.2135E 06	0.2729E 01	0.236E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

LOSS COEFFICIENT IS FOR CONTROL DRUM INNER TUBES FROM 5.1 TO 7.1. AREA BASED ON (4) 0.180 DIA
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

	P1 PSIG	PXA PSIA	DTLPXY PSI"	TEMP DEG R	FLGW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	135.07	0.6326E 00	523.5	0.323E-01	37.68	0.5593E 05	0.1959E 01	0.587E-01
2	121.00	135.31	0.7659E 00	531.5	0.356E-01	37.44	0.6153E 05	0.1969E 01	0.649E-01
3	120.30	134.81	0.9573E 00	528.0	0.395E-01	37.86	0.6853E 05	0.1958E 01	0.720E-01
4	120.30	134.81	0.1051E 01	527.0	0.424E-01	37.42	0.7360E 05	0.1924E 01	0.772E-01
5	121.50	135.01	0.1253E 01	527.0	0.452E-01	37.71	0.7860E 05	0.1895E 01	0.817E-01
6	121.20	135.31	0.1375E 01	527.0	0.477E-01	37.55	0.8282E 05	0.1941E 01	0.865E-01
7	121.00	135.11	0.1621E 01	527.0	0.490E-01	36.69	0.8506E 05	0.2165E 01	0.890E-01
8	121.30	135.06	0.1655E 01	527.0	0.518E-01	37.09	0.8995E 05	0.2024E 01	0.941E-01
9	120.30	134.34	0.1793E 01	531.5	0.541E-01	37.30	0.9342E 05	0.1934E 01	0.993E-01
10	121.00	134.64	0.1940E 01	529.5	0.559E-01	37.05	0.9676E 05	0.1974E 01	0.102E-00
11	120.60	134.34	0.2186E 01	528.5	0.574E-01	36.73	0.9954E 05	0.2106E 01	0.105E-00
12	121.00	134.45	0.2455E 01	527.5	0.599E-01	37.09	0.1041E 06	0.2177E 01	0.110E-00
13	121.30	134.35	0.2711E 01	527.0	0.614E-01	36.87	0.1067E 06	0.2290E 01	0.112E-00
14	121.10	134.55	0.2956E 01	527.0	0.621E-01	36.25	0.1079E 06	0.2478E 01	0.113E-00
15	121.50	134.65	0.3153E 01	526.0	0.641E-01	36.45	0.1116E 06	0.2481E 01	0.117E-00
16	121.5	134.45	0.3561E 01	526.0	0.653E-01	36.20	0.1136E 06	0.2667E 01	0.119E-00
17	120.30	132.36	0.2726E 01	528.0	0.719E-01	38.13	0.1247E 06	0.1653E 01	0.133E-00
18	120.50	133.11	0.3954E 01	527.5	0.709E-01	36.06	0.1230E 06	0.2481E 01	0.131E-00
19	120.10	132.86	0.4755E 01	527.5	0.748E-01	36.69	0.1299E 06	0.2679E 01	0.138E-00
20	121.10	132.73	0.3316E 01	525.5	0.811E-01	38.18	0.1412E 06	0.1593E 01	0.150E-00
21	121.50	132.18	0.6377E 01	524.5	0.910E-01	36.00	0.1586E 06	0.2615E 01	0.169E-00
22	121.00	130.93	0.1014E 02	524.5	0.101E-00	35.62	0.1762E 06	0.3096E 01	0.189E-00
23	120.75	128.93	0.1181E 02	523.5	0.111E-00	36.09	0.1945E 06	0.2926E 01	0.212E-00
24	120.50	127.73	0.1331E 02	523.5	0.121E-00	36.61	0.2108E 06	0.2826E 01	0.231E-00
25	120.70	129.43	0.1086E 02	524.0	0.109E-00	36.77	0.1903E 06	0.2812E 01	0.206E-00
26	120.00	127.63	0.1232E 02	524.0	0.120E-00	37.45	0.2087E 06	0.2724E 01	0.230E-00

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04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
RUN DATE NOVEMBER 6, 1963

NOZZLE END BEARING SHAFT

-NUMBER 1
-RING CLEARANCE (INCH) 0.0064
-PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT

-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DEL PXY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	PEYN	COEFPL	MACH
1	122.50	137.04	0.7850E 00	533.5	0.540E-01	63.48	0.4651E 05	0.3458E 01	0.487E-01
2	110.75	134.00	0.7824E 00	533.5	0.603E-01	63.59	0.5198E 05	0.3388E 01	0.556E-01
3	121.20	135.49	0.1179E 01	533.5	0.668E-01	64.45	0.5757E 05	0.3348E 01	0.610E-01
4	121.20	135.79	0.1424E 01	534.5	0.715E-01	64.05	0.6151E 05	0.3536E 01	0.651E-01
5	121.00	135.29	0.1572E 01	534.5	0.771E-01	64.80	0.6636E 05	0.3340E 01	0.705E-01
6	119.50	133.93	0.1867E 01	534.5	0.809E-01	64.21	0.6956E 05	0.3575E 01	0.746E-01
7	122.30	136.54	0.2063E 01	534.5	0.854E-01	64.53	0.7351E 05	0.3607E 01	0.774E-01
8	120.50	134.79	0.2210E 01	534.5	0.890E-01	64.28	0.7659E 05	0.3513E 01	0.817E-01
9	119.00	133.29	0.2456E 01	533.5	0.927E-01	64.13	0.7984E 05	0.3568E 01	0.859E-01
10	120.75	135.05	0.2505E 01	534.5	0.955E-01	64.39	0.8301E 05	0.3396E 01	0.884E-01
11	122.00	136.10	0.2849E 01	534.5	0.100E-00	64.55	0.8618E 05	0.3611E 01	0.910E-01
12	120.00	134.30	0.3242E 01	534.5	0.103E-00	64.51	0.8895E 05	0.3806E 01	0.952E-01
13	120.20	134.50	0.3340E 01	534.5	0.106E-00	64.24	0.9127E 05	0.3730E 01	0.976E-01
14	121.60	135.80	0.3438E 01	534.5	0.109E-00	64.32	0.9400E 05	0.3655E 01	0.995E-01
15	120.50	134.50	0.4625E 01	534.5	0.112E-00	64.23	0.9628E 05	0.3638E 01	0.103E-00
16	121.00	135.30	0.3890E 01	534.5	0.115E-00	64.42	0.9905E 05	0.3701E 01	0.105E-00
17	119.75	134.07	0.3779E 01	535.0	0.113E-00	64.55	0.1021E 06	0.3533E 01	0.110E-00
18	119.00	132.97	0.4176E 01	532.5	0.122E-00	64.61	0.1051E 06	0.3468E 01	0.113E-00
19	120.50	134.47	0.4347E 01	532.0	0.124E-00	64.55	0.1073E 06	0.3551E 01	0.114E-00
20	121.00	134.77	0.4519E 01	531.0	0.128E-00	64.94	0.1104E 06	0.3513E 01	0.117E-00
21	120.10	134.17	0.4544E 01	530.0	0.131E-00	65.11	0.1130E 06	0.3372E 01	0.120E-00
22	120.00	134.17	0.4759E 01	526.5	0.133E-00	64.69	0.1152E 06	0.3470E 01	0.121E-00
23	119.00	132.86	0.5257E 01	527.0	0.137E-00	64.49	0.1191E 06	0.3488E 01	0.127E-00
24	119.50	132.96	0.5747E 01	526.5	0.144E-00	64.40	0.1254E 06	0.3486E 01	0.133E-00
25	120.00	133.44	0.5736E 01	533.0	0.149E-00	64.10	0.1295E 06	0.3263E 01	0.138E-00
26	120.20	133.54	0.6729E 01	532.5	0.156E-00	64.46	0.1348E 06	0.3452E 01	0.144E-00
27	120.00	133.44	0.7000E 01	532.5	0.162E-00	64.54	0.1398E 06	0.3334E 01	0.150E-00
28	119.80	132.84	0.7442E 01	531.5	0.167E-00	64.34	0.1443E 06	0.3328E 01	0.155E-00
29	119.50	132.44	0.7270E 01	531.5	0.170E-00	63.64	0.1471E 06	0.3121E 01	0.159E-00
30	120.30	133.44	0.7854E 01	531.5	0.175E-00	63.59	0.1512E 06	0.3224E 01	0.162E-00
31	120.50	132.94	0.9135E 01	531.0	0.187E-00	63.40	0.1619E 06	0.3254E 01	0.174E-00
32	120.50	133.19	0.9677E 01	531.5	0.195E-00	63.35	0.1681E 06	0.3197E 01	0.180E-00
33	120.50	133.01	0.1046E 02	531.5	0.200E-00	63.16	0.1729E 06	0.3264E 01	0.186E-00
34	120.30	132.26	0.1120E 02	532.0	0.207E-00	63.24	0.1785E 06	0.3251E 01	0.193E-00
35	119.85	131.41	0.1194E 02	532.0	0.212E-00	63.22	0.1832E 06	0.3270E 01	0.199E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT
-NUMBER 2
-RING CLEARANCE (INCH) 0.0498
-PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT
-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500
FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.96	0.8596E 00	533.0	0.547E-01	64.06	0.4712E 05	0.3638E 01	0.500E-01
2	120.75	135.36	0.1032E 01	531.5	0.609E-01	63.88	0.5256E 05	0.3543E 01	0.555E-01
3	120.50	134.97	0.1233E 01	531.5	0.666E-01	63.89	0.5748E 05	0.3530E 01	0.608E-01
4	120.20	134.57	0.1518E 01	531.5	0.706E-01	62.94	0.6102E 05	0.3846E 01	0.648E-01
5	121.20	135.57	0.1635E 01	531.5	0.768E-01	64.22	0.6636E 05	0.3657E 01	0.699E-01
6	121.00	135.37	0.1957E 01	531.5	0.820E-01	64.80	0.7086E 05	0.3685E 01	0.748E-01
7	120.75	135.12	0.2161E 01	533.0	0.861E-01	64.79	0.7425E 05	0.3688E 01	0.787E-01
8	121.75	136.11	0.2455E 01	533.0	0.901E-01	64.83	0.7770E 05	0.3856E 01	0.818E-01
9	120.80	135.11	0.2603E 01	533.0	0.933E-01	64.42	0.8040E 05	0.3788E 01	0.853E-01
10	120.75	134.32	0.2702E 01	535.0	0.961E-01	64.06	0.8261E 05	0.3670E 01	0.885E-01
11	120.50	134.92	0.3119E 01	536.5	0.995E-01	64.20	0.8537E 05	0.3958E 01	0.914E-01
12	120.20	134.82	0.3585E 01	536.5	0.102E-00	63.89	0.8780E 05	0.4299E 01	0.940E-01
13	121.50	136.82	0.4028E 01	536.5	0.105E-00	63.64	0.9006E 05	0.4657E 01	0.951E-01
14	120.60	134.92	0.4224E 01	536.0	0.107E-00	62.81	0.9156E 05	0.4670E 01	0.979E-01
15	121.00	135.52	0.4519E 01	536.0	0.110E-00	63.08	0.9437E 05	0.4724E 01	0.100E-00
16	121.00	135.82	0.4765E 01	537.5	0.112E-00	62.92	0.9609E 05	0.4783E 01	0.102E-00
17	120.75	134.99	0.4765E 01	533.0	0.118E-00	63.19	0.1019E 06	0.4312E 01	0.108E-00
18	121.30	135.39	0.5693E 01	531.5	0.124E-00	63.41	0.1069E 06	0.4736E 01	0.113E-00
19	120.60	134.79	0.6239E 01	531.0	0.127E-00	62.84	0.1101E 06	0.4877E 01	0.116E-00
20	120.60	134.69	0.6877E 01	531.0	0.133E-00	62.62	0.1145E 06	0.4961E 01	0.121E-00
21	119.85	134.09	0.8105E 01	531.0	0.145E-00	62.54	0.1252E 06	0.4868E 01	0.133E-00
22	120.75	134.29	0.1233E 02	531.0	0.175E-00	62.36	0.1515E 06	0.5090E 01	0.161E-00
23	120.00	133.29	0.1523E 02	530.0	0.191E-00	62.38	0.1652E 06	0.5249E 01	0.176E-00
24	120.00	132.79	0.1734E 02	530.5	0.204E-00	62.24	0.1763E 06	0.5216E 01	0.189E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16
 RUN DATE NOVEMBER 7-11, 1963

NOZZLE END BEARING SHAFT

-NUMBER

3

-RING CLEARANCE (INCH)

0.1264

-PLENUM DEPTH (INCH)

0.2514

DRIVE SHAFT

-NUMBER

2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DEL PX PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	119.50	132.72	0.8447E 00	535.5	0.539E-01	63.22	0.4630E 05	0.3602E 01	0.503E-01
2	116.00	134.21	0.1032E 01	537.5	0.598E-01	63.51	0.5127E 05	0.3594E 01	0.553E-01
3	120.50	134.96	0.1277E 01	538.0	0.654E-01	63.55	0.5602E 05	0.3739E 01	0.601E-01
4	120.50	134.71	0.1424E 01	538.0	0.705E-01	63.64	0.6042E 05	0.3580E 01	0.650E-01
5	121.50	135.41	0.1621E 01	537.0	0.753E-01	63.59	0.6455E 05	0.3616E 01	0.687E-01
6	121.30	135.71	0.1857E 01	538.0	0.794E-01	63.40	0.6797E 05	0.3714E 01	0.726E-01
7	120.60	134.81	0.2151E 01	536.5	0.840E-01	63.74	0.7206E 05	0.3829E 01	0.772E-01
8	121.70	136.22	0.2359E 01	537.5	0.876E-01	63.59	0.7506E 05	0.3890E 01	0.798E-01
9	120.30	134.52	0.2579E 01	537.5	0.911E-01	63.45	0.7808E 05	0.3883E 01	0.840E-01
10	120.50	134.72	0.2800E 01	536.0	0.950E-01	63.69	0.8161E 05	0.3891E 01	0.874E-01
11	121.10	133.65	0.2554E 01	536.0	0.912E-01	63.39	0.7833E 05	0.3823E 01	0.845E-01
12	121.00	134.25	0.2849E 01	536.0	0.949E-01	63.57	0.8151E 05	0.3955E 01	0.876E-01
13	120.75	134.75	0.3242E 01	536.0	0.985E-01	63.67	0.8456E 05	0.4198E 01	0.905E-01
14	120.00	134.26	0.3217E 01	535.5	0.102E-00	63.79	0.8763E 05	0.3874E 01	0.940E-01
15	120.70	134.96	0.3635E 01	535.5	0.103E-00	62.81	0.8892E 05	0.4272E 01	0.949E-01
16	121.20	135.46	0.3831E 01	535.5	0.106E-00	62.75	0.9133E 05	0.4285E 01	0.971E-01
17	120.00	134.36	0.4224E 01	526.0	0.112E-00	63.73	0.9763E 05	0.4278E 01	0.102E-00
18	120.50	134.46	0.4421E 01	524.0	0.116E-00	64.08	0.1010E 06	0.4235E 01	0.105E-00
19	120.75	135.10	0.4814E 01	524.0	0.122E-00	64.28	0.1060E 06	0.4193E 01	0.110E-00
20	120.75	134.95	0.5526E 01	524.5	0.126E-00	64.11	0.1100E 06	0.4462E 01	0.115E-00
21	120.00	134.15	0.6115E 01	524.5	0.131E-00	64.04	0.1141E 06	0.4561E 01	0.120E-00
22	121.20	135.10	0.6287E 01	523.0	0.136E-00	63.98	0.1187E 06	0.4392E 01	0.123E-00
23	119.50	132.85	0.9578E 01	522.5	0.161E-00	63.39	0.1404E 06	0.4716E 01	0.148E-00
24	120.10	133.34	0.1019E 02	526.0	0.179E-00	63.25	0.1554E 06	0.4046E 01	0.164E-00
25	119.90	132.74	0.1415E 02	525.0	0.193E-00	62.92	0.1684E 06	0.4779E 01	0.179E-00
26	120.60	133.59	0.1635E 02	525.0	0.206E-00	62.70	0.1792E 06	0.5039E 01	0.190E-00
27	120.00	132.84	0.1314E 02	525.0	0.196E-00	62.97	0.1621E 06	0.4798E 01	0.172E-00
28	120.00	132.84	0.1667E 02	524.0	0.196E-00	61.61	0.1713E 06	0.5541E 01	0.181E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 2.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	134.92	0.8105E 00	528.5	0.533E-01	62.32	0.4625E 05	0.3632E 01	0.486E-01
2	121.00	135.51	0.1007E 01	531.5	0.595E-01	62.56	0.5141E 05	0.3619E 01	0.542E-01
3	120.30	134.81	0.1253E 01	528.0	0.648E-01	62.14	0.5624E 05	0.3801E 01	0.591E-01
4	120.30	134.81	0.1424E 01	527.0	0.708E-01	62.58	0.6155E 05	0.3626E 01	0.645E-01
5	121.50	136.06	0.1594E 01	527.0	0.747E-01	62.29	0.6492E 05	0.3687E 01	0.674E-01
6	121.20	135.51	0.1817E 01	527.0	0.793E-01	62.45	0.6888E 05	0.3713E 01	0.719E-01
7	121.00	135.41	0.2063E 01	527.0	0.845E-01	63.31	0.7338E 05	0.3711E 01	0.766E-01
8	121.30	135.61	0.2185E 01	527.0	0.878E-01	62.91	0.7628E 05	0.3644E 01	0.795E-01
9	120.30	134.64	0.2362E 01	531.5	0.909E-01	62.70	0.7851E 05	0.3648E 01	0.833E-01
10	121.00	135.34	0.2603E 01	529.5	0.949E-01	62.95	0.8221E 05	0.3688E 01	0.864E-01
11	120.60	134.94	0.2924E 01	528.5	0.989E-01	63.27	0.8572E 05	0.3685E 01	0.901E-01
12	121.00	135.15	0.3095E 01	527.5	0.102E-00	62.91	0.8823E 05	0.3834E 01	0.924E-01
13	121.00	135.10	0.3438E 01	527.0	0.105E-00	63.13	0.9132E 05	0.3985E 01	0.956E-01
14	121.10	135.35	0.3635E 01	527.0	0.109E-00	63.75	0.9486E 05	0.3911E 01	0.991E-01
15	121.50	135.85	0.4025E 01	526.0	0.112E-00	63.55	0.9728E 05	0.4155E 01	0.101E-00
16	121.50	135.75	0.4224E 01	526.0	0.115E-00	63.80	0.1001E 06	0.4112E 01	0.104E-00
17	120.00	134.16	0.3850E 01	528.0	0.117E-00	61.87	0.1011E 06	0.3601E 01	0.107E-00
18	120.50	134.86	0.4987E 01	527.5	0.126E-00	63.94	0.1091E 06	0.3953E 01	0.114E-00
19	120.10	134.36	0.5694E 01	527.5	0.129E-00	63.31	0.1121E 06	0.4350E 01	0.118E-00
20	121.10	135.18	0.4740E 01	525.5	0.131E-00	61.82	0.1143E 06	0.3535E 01	0.119E-00
21	121.50	135.03	0.7757E 01	524.5	0.162E-00	64.00	0.1410E 06	0.3911E 01	0.147E-00
22	121.00	134.43	0.1140E 02	524.5	0.183E-00	64.38	0.1592E 06	0.4371E 01	0.167E-00
23	120.75	133.93	0.1326E 02	523.5	0.197E-00	63.91	0.1723E 06	0.4351E 01	0.180E-00
24	120.50	133.43	0.1601E 02	523.5	0.209E-00	63.39	0.1825E 06	0.4663E 01	0.192E-00
25	120.70	134.18	0.1277E 02	524.0	0.188E-00	63.23	0.1637E 06	0.4638E 01	0.171E-00
26	120.00	133.33	0.1513E 02	524.0	0.200E-00	62.55	0.1743E 06	0.4817E 01	0.184E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 14
 RUN DATE NOVEMBER 5, 1965

NOZZLE END BEARING SHAFT

-NUMBER 1
 -RING CLEARANCE (INCH) 0.0064
 -PLENUM DEPTH (INCH) 0.1314

DRIVE SHAFT
 - DUMPER

2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUPES FROM 3.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIA	PXA PSIA	DELPRY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	122.50	138.23	0.6091E 00	533.5	0.540E-01	63.48	0.4651E 05	0.2705E 01	0.482E-01
2	119.75	135.04	0.7857E 00	533.5	0.603E-01	63.59	0.5108E 05	0.2729E 01	0.552E-01
3	121.20	136.79	0.9333E 00	533.5	0.668E-01	64.45	0.5757E 05	0.2676E 01	0.604E-01
4	121.20	136.79	0.1130E 01	534.5	0.715E-01	64.05	0.6151E 05	0.2825E 01	0.647E-01
5	121.00	136.49	0.1277E 01	534.5	0.771E-01	64.80	0.6636E 05	0.2758E 01	0.699E-01
6	119.50	134.50	0.1424E 01	534.5	0.809E-01	64.21	0.6956E 05	0.2740E 01	0.743E-01
7	122.50	137.49	0.1572E 01	534.5	0.854E-01	64.53	0.7351E 05	0.2766E 01	0.769E-01
8	120.50	135.59	0.1744E 01	534.5	0.890E-01	64.23	0.7659E 05	0.2787E 01	0.817E-01
9	119.00	134.09	0.1857E 01	533.5	0.927E-01	64.13	0.7944E 05	0.2728E 01	0.854E-01
10	120.75	135.70	0.1967E 01	534.5	0.965E-01	64.39	0.8301E 05	0.2680E 01	0.878E-01
11	122.00	136.60	0.2161E 01	534.5	0.100E-00	64.55	0.8618E 05	0.2753E 01	0.906E-01
12	120.00	134.80	0.2407E 01	534.5	0.103E-00	64.51	0.8895E 05	0.2836E 01	0.949E-01
13	120.20	134.50	0.2455E 01	534.5	0.106E-00	64.24	0.9127E 05	0.2749E 01	0.973E-01
14	121.60	136.50	0.2751E 01	534.5	0.109E-00	64.32	0.9400E 05	0.2935E 01	0.992E-01
15	120.50	134.80	0.2849E 01	534.5	0.112E-00	64.23	0.9628E 05	0.2865E 01	0.103E-00
16	121.00	135.50	0.2947E 01	534.5	0.115E-00	64.42	0.9905E 05	0.2815E 01	0.105E-00
17	119.75	134.00	0.3095E 01	535.0	0.119E-00	64.55	0.1021E 06	0.2748E 01	0.110E-00
18	119.00	133.17	0.3168E 01	532.5	0.122E-00	64.61	0.1051E 06	0.2667E 01	0.113E-00
19	120.50	134.47	0.3330E 01	532.0	0.124E-00	64.55	0.1073E 06	0.2720E 01	0.114E-00
20	121.00	134.67	0.3557E 01	531.0	0.128E-00	64.94	0.1104E 06	0.2747E 01	0.117E-00
21	120.10	133.97	0.3409E 01	530.0	0.131E-00	65.11	0.1130E 06	0.2584E 01	0.120E-00
22	120.00	133.77	0.3625E 01	526.5	0.133E-00	64.67	0.1152E 06	0.2623E 01	0.121E-00
23	119.00	132.46	0.3905E 01	527.0	0.137E-00	64.49	0.1171E 06	0.2608E 01	0.127E-00
24	119.50	132.76	0.4421E 01	526.5	0.144E-00	64.40	0.1254E 06	0.2677E 01	0.133E-00
25	120.00	132.94	0.4323E 01	533.0	0.149E-00	64.10	0.1285E 06	0.2474E 01	0.138E-00
26	120.20	133.14	0.5153E 01	532.5	0.156E-00	64.46	0.1348E 06	0.2637E 01	0.145E-00
27	120.00	132.94	0.5330E 01	532.5	0.162E-00	64.54	0.1398E 06	0.2529E 01	0.151E-00
28	119.80	131.94	0.5551E 01	531.5	0.167E-00	64.34	0.1443E 06	0.2466E 01	0.156E-00
29	119.50	131.94	0.5452E 01	531.5	0.170E-00	63.64	0.1471E 06	0.2332E 01	0.159E-00
30	120.30	132.44	0.5993E 01	531.5	0.175E-00	63.59	0.1512E 06	0.2432E 01	0.163E-00
31	120.50	131.94	0.6779E 01	531.0	0.187E-00	63.40	0.1619E 06	0.2396E 01	0.175E-00
32	120.50	131.74	0.7221E 01	531.5	0.195E-00	63.35	0.1681E 06	0.2359E 01	0.182E-00
33	120.50	131.61	0.7751E 01	531.5	0.200E-00	63.16	0.1729E 06	0.2396E 01	0.188E-00
34	120.30	130.71	0.8350E 01	532.0	0.207E-00	63.24	0.1785E 06	0.2395E 01	0.195E-00
35	119.85	129.51	0.8891E 01	532.0	0.212E-00	63.22	0.1832E 06	0.2401E 01	0.202E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 15
RUN DATE NOVEMBER 5, 1963

NOZZLE END BEARING SHAFT
-NUMBER 2
-RING CLEARANCE (INCH) 0.0498
-PLENUM DEPTH (INCH) 0.1748

DRIVE SHAFT
-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT IS FOR CONTROL DRUM CUTTER TUBES FROM 3.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.50	136.36	0.6877E 00	533.0	0.547E-01	64.06	0.4712E 05	0.2940E 01	0.495E-01
2	120.75	136.56	0.7859E 00	531.5	0.609E-01	63.88	0.5256E 05	0.2723E 01	0.550E-01
3	120.50	136.17	0.9726E 00	531.5	0.666E-01	63.89	0.5748E 05	0.2810E 01	0.603E-01
4	120.20	135.57	0.1135E 01	531.5	0.706E-01	62.94	0.6102E 05	0.2896E 01	0.643E-01
5	121.20	136.57	0.1277E 01	531.5	0.768E-01	64.22	0.6636E 05	0.2776E 01	0.694E-01
6	121.00	136.37	0.1474E 01	531.5	0.820E-01	64.80	0.7086E 05	0.2805E 01	0.742E-01
7	120.75	136.07	0.1670E 01	533.0	0.861E-01	64.79	0.7425E 05	0.2870E 01	0.782E-01
8	121.75	135.86	0.1768E 01	533.0	0.901E-01	64.83	0.7770E 05	0.2771E 01	0.819E-01
9	120.80	135.86	0.1965E 01	533.0	0.933E-01	64.42	0.8040E 05	0.2875E 01	0.848E-01
10	120.75	134.62	0.2014E 01	535.0	0.961E-01	64.06	0.8261E 05	0.2742E 01	0.883E-01
11	120.50	135.52	0.2505E 01	536.5	0.995E-01	64.20	0.8537E 05	0.3193E 01	0.910E-01
12	120.20	135.52	0.2751E 01	536.5	0.102E-00	63.89	0.8780E 05	0.3315E 01	0.936E-01
13	121.50	137.07	0.2957E 01	536.5	0.105E-00	63.64	0.9006E 05	0.3425E 01	0.949E-01
14	120.60	135.32	0.3242E 01	536.0	0.107E-00	62.81	0.9156E 05	0.3595E 01	0.976E-01
15	121.00	136.02	0.3537E 01	536.0	0.110E-00	63.08	0.9437E 05	0.3711E 01	0.100E-00
16	121.00	136.22	0.3635E 01	537.5	0.112E-00	62.92	0.9609E 05	0.3660E 01	0.102E-00
17	120.75	135.04	0.3930E 01	533.0	0.118E-00	63.19	0.1019E 06	0.3557E 01	0.108E-00
18	121.30	135.49	0.4323E 01	531.5	0.124E-00	63.41	0.1069E 06	0.3595E 01	0.113E-00
19	120.60	134.59	0.4912E 01	531.0	0.127E-00	62.84	0.1101E 06	0.3834E 01	0.117E-00
20	120.60	134.59	0.5207E 01	531.0	0.133E-00	62.62	0.1145E 06	0.3754E 01	0.121E-00
21	119.85	133.29	0.6484E 01	531.0	0.145E-00	62.54	0.1252E 06	0.3872E 01	0.134E-00
22	120.75	132.99	0.9628E 01	531.0	0.175E-00	62.36	0.1515E 06	0.3920E 01	0.162E-00
23	120.00	131.29	0.1228E 02	530.0	0.191E-00	62.38	0.1652E 06	0.4169E 01	0.179E-00
24	120.00	129.29	0.1375E 02	530.5	0.204E-00	62.24	0.1763E 06	0.4028E 01	0.194E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 16 NOZZLE END BEARING SHAFT
 RUN DATE NOVEMBER 7-11, 1963 -NUMBER 3
 -RING CLEARANCE (INCH) 0.1264
 DRIVE SHAFT -PLENUM DEPTH (INCH) 0.2514
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 3.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFFPL	MACH
1	119.50	133.82	0.6631E 00	535.5	0.539E-01	63.22	0.4630E 05	0.2851E 01	0.498E-01
2	119.00	134.71	0.8105E 00	537.5	0.598E-01	63.51	0.5127E 05	0.2834E 01	0.551E-01
3	120.50	136.21	0.9726E 00	538.0	0.654E-01	63.55	0.5602E 05	0.2874E 01	0.596E-01
4	120.50	136.21	0.1081E 01	538.0	0.705E-01	63.64	0.6042E 05	0.2746E 01	0.643E-01
5	121.50	136.81	0.1228E 01	537.0	0.753E-01	63.59	0.6455E 05	0.2758E 01	0.682E-01
6	121.30	136.41	0.1449E 01	538.0	0.794E-01	63.40	0.6797E 05	0.2913E 01	0.722E-01
7	120.60	136.01	0.1572E 01	536.5	0.840E-01	63.74	0.7206E 05	0.2823E 01	0.765E-01
8	121.90	136.82	0.1817E 01	537.5	0.876E-01	63.59	0.7506E 05	0.3012E 01	0.794E-01
9	120.30	134.92	0.2038E 01	537.5	0.911E-01	63.45	0.7808E 05	0.3079E 01	0.838E-01
10	120.50	135.02	0.2063E 01	536.0	0.950E-01	63.69	0.8161E 05	0.2873E 01	0.872E-01
11	121.10	136.15	0.1842E 01	536.0	0.912E-01	63.39	0.7833E 05	0.2808E 01	0.830E-01
12	121.00	135.75	0.2003E 01	536.0	0.949E-01	63.57	0.8151E 05	0.2900E 01	0.865E-01
13	120.75	135.75	0.2260E 01	536.0	0.985E-01	63.67	0.8456E 05	0.2947E 01	0.898E-01
14	120.00	134.26	0.2309E 01	535.5	0.102E-00	63.79	0.8763E 05	0.2780E 01	0.940E-01
15	120.70	135.26	0.2554E 01	535.5	0.103E-00	62.81	0.8892E 05	0.3009E 01	0.947E-01
16	121.20	135.96	0.2849E 01	535.5	0.106E-00	62.75	0.9133E 05	0.3198E 01	0.968E-01
17	120.00	134.36	0.2946E 01	526.0	0.112E-00	63.73	0.9763E 05	0.3035E 01	0.102E-00
18	120.50	134.86	0.3340E 01	524.0	0.116E-00	64.08	0.1010E 06	0.3200E 01	0.105E-00
19	120.75	135.10	0.3537E 01	524.0	0.122E-00	64.28	0.1060E 06	0.3081E 01	0.110E-00
20	120.75	134.65	0.4273E 01	524.5	0.126E-00	64.11	0.1100E 06	0.3443E 01	0.115E-00
21	120.00	134.10	0.4716E 01	524.5	0.131E-00	64.04	0.1141E 06	0.3516E 01	0.120E-00
22	121.20	134.85	0.4863E 01	523.0	0.136E-00	63.98	0.1187E 06	0.3391E 01	0.123E-00
23	119.50	131.85	0.7564E 01	522.5	0.161E-00	63.39	0.1404E 06	0.3696E 01	0.149E-00
24	120.10	131.84	0.7368E 01	526.0	0.179E-00	63.25	0.1554E 06	0.2892E 01	0.166E-00
25	119.90	130.44	0.1032E 02	525.0	0.193E-00	62.92	0.1684E 06	0.3424E 01	0.182E-00
26	120.50	130.34	0.1202E 02	525.0	0.206E-00	62.70	0.1792E 06	0.3697E 01	0.194E-00
27	120.00	130.84	0.9624E 01	525.0	0.186E-00	62.97	0.1621E 06	0.3533E 01	0.174E-00
28	120.00	130.34	0.1282E 02	524.0	0.196E-00	61.61	0.1713E 06	0.4131E 01	0.184E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 17
 RUN DATE NOVEMBER 12, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR CONTROL DRUM OUTER TUBES FROM 3.1 TO 9.1. AREA IS FOR 8-0.180 DIA HOLES.

	PI PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.5	130.32	0.6140E 00	528.5	0.533E-01	62.32	0.4625E 05	0.2780E 01	0.481E-01
2	121.00	130.81	0.7859E 00	531.5	0.595E-01	62.56	0.5141E 05	0.2852E 01	0.537E-01
3	120.30	136.11	0.9726E 00	528.0	0.649E-01	62.14	0.5624E 05	0.2980E 01	0.585E-01
4	120.30	135.81	0.1081E 01	527.0	0.708E-01	62.58	0.6155E 05	0.2771E 01	0.641E-01
5	121.50	137.01	0.1184E 01	527.0	0.747E-01	62.29	0.6492E 05	0.2765E 01	0.670E-01
6	121.20	136.81	0.1375E 01	527.0	0.793E-01	62.45	0.6888E 05	0.2837E 01	0.712E-01
7	121.00	136.31	0.1572E 01	527.0	0.845E-01	63.31	0.7338E 05	0.2846E 01	0.761E-01
8	121.30	136.81	0.1670E 01	527.0	0.878E-01	62.91	0.7628E 05	0.2809E 01	0.788E-01
9	121.30	135.14	0.1793E 01	531.5	0.909E-01	62.70	0.7851E 05	0.2755E 01	0.830E-01
10	121.00	136.03	0.1867E 01	529.5	0.949E-01	62.95	0.8221E 05	0.2659E 01	0.859E-01
11	120.60	135.84	0.2112E 01	528.5	0.989E-01	63.27	0.8572E 05	0.2774E 01	0.895E-01
12	121.00	135.85	0.2260E 01	527.5	0.102E-00	62.91	0.8823E 05	0.2814E 01	0.919E-01
13	121.00	135.85	0.2603E 01	527.0	0.105E-00	63.13	0.9132E 05	0.3034E 01	0.950E-01
14	121.10	135.65	0.2751E 01	527.0	0.109E-00	63.75	0.9486E 05	0.2971E 01	0.987E-01
15	121.50	136.45	0.2947E 01	526.0	0.112E-00	63.55	0.9728E 05	0.3054E 01	0.101E-00
16	121.50	136.35	0.3193E 01	526.0	0.115E-00	63.80	0.1001E 06	0.3122E 01	0.104E-00
17	121.00	134.36	0.2849E 01	528.0	0.117E-00	61.87	0.1011E 06	0.2665E 01	0.107E-00
18	120.50	134.86	0.3537E 01	527.5	0.126E-00	63.94	0.1091E 06	0.2860E 01	0.114E-00
19	120.10	134.36	0.4421E 01	527.5	0.129E-00	63.31	0.1121E 06	0.3375E 01	0.118E-00
20	121.10	135.03	0.3365E 01	525.5	0.131E-00	61.82	0.1143E 06	0.2506E 01	0.119E-00
21	121.50	134.43	0.5894E 01	524.5	0.162E-00	64.00	0.1410E 06	0.2884E 01	0.147E-00
22	121.00	132.93	0.8621E 01	524.5	0.134E-00	64.38	0.1592E 06	0.3269E 01	0.168E-00
23	120.75	131.63	0.9947E 01	523.5	0.197E-00	63.91	0.1723E 06	0.3207E 01	0.184E-00
24	120.50	130.93	0.1253E 02	523.5	0.209E-00	63.39	0.1825E 06	0.3579E 01	0.195E-00
25	120.70	132.33	0.9775E 01	524.0	0.188E-00	63.23	0.1637E 06	0.3501E 01	0.174E-00
26	120.00	130.93	0.1169E 02	524.0	0.200E-00	62.55	0.1743E 06	0.3655E 01	0.187E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 1
 RUN DATE NINE SEP 20, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT
 -NUMBER
 -DISCHARGE HOLE SIZE (INCH) 0.2500
 FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR ONE END BEARING SHAFT FROM 7 TO 10. AREA AND FLOW IS BASED ON 0.505 DIA.

	P1 PSI	PXA PSIA	DELPXY PSI	TEMP DEG F	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.75	133.02	0.1253E 01	531.0	0.959E-01	100.00	0.2361E 06	0.1652E 01	0.903E-01
2	121.50	133.27	0.1056E 01	527.0	0.106E-0	100.00	0.2615E 06	0.1159E 01	0.789E-01
3	120.20	131.72	0.176E 01	526.5	0.113E-02	100.00	0.2810E 06	0.1665E 01	0.107E-00
4	120.50	132.25	0.177E 01	529.0	0.121E-00	100.00	0.2986E 06	0.1655E 01	0.114E-00
5	120.70	132.00	0.2224E 01	526.5	0.123E-00	100.00	0.3168E 06	0.1696E 01	0.121E-00
6	120.70	131.77	0.2456E 01	526.5	0.134E-00	100.00	0.3330E 06	0.1650E 01	0.127E-00
7	121.50	132.24	0.2702E 01	526.5	0.141E-00	100.00	0.3483E 06	0.1662E 01	0.133E-00
8	120.50	130.77	0.293E 01	526.5	0.147E-00	100.00	0.3640E 06	0.1616E 01	0.140E-00
9	121.70	132.17	0.3075E 01	526.5	0.152E-00	100.00	0.3770E 06	0.1624E 01	0.144E-00
10	121.00	131.21	0.334E 01	528.0	0.157E-00	100.00	0.3884E 06	0.1629E 01	0.149E-00
11	121.00	130.76	0.3586E 01	528.0	0.162E-00	100.00	0.4012E 06	0.1635E 01	0.155E-00
12	121.20	131.21	0.3407E 01	528.0	0.167E-00	100.00	0.4134E 06	0.1639E 01	0.159E-00
13	119.80	129.07	0.4273E 01	530.5	0.172E-00	100.00	0.4245E 06	0.1696E 01	0.167E-00
14	120.75	130.07	0.4421E 01	526.0	0.177E-00	100.00	0.4400E 06	0.1680E 01	0.170E-00
15	122.00	131.07	0.4417E 01	523.5	0.167E-00	100.00	0.4537E 06	0.1682E 01	0.173E-00
16	120.50	129.57	0.4912E 01	523.5	0.187E-00	100.00	0.4644E 06	0.1683E 01	0.179E-00
17	120.50	129.57	0.5154E 01	523.0	0.191E-00	100.00	0.4753E 06	0.1696E 01	0.183E-00
18	120.75	129.33	0.5305E 01	523.5	0.195E-00	100.00	0.4850E 06	0.1669E 01	0.187E-00
19	120.50	128.70	0.5575E 01	523.5	0.199E-00	100.00	0.4948E 06	0.1676E 01	0.192E-00
20	121.75	129.61	0.5722E 01	526.0	0.202E-00	100.00	0.5018E 06	0.1666E 01	0.195E-00
21	120.00	128.31	0.6042E 01	526.0	0.206E-00	100.00	0.5112E 06	0.1678E 01	0.200E-00
22	120.80	128.51	0.6559E 01	533.0	0.212E-00	100.00	0.5197E 06	0.1710E 01	0.207E-00
23	119.50	124.51	0.9776E 01	530.5	0.252E-00	100.00	0.6213E 06	0.1787E 01	0.253E-00
24	119.70	121.00	0.1353E 02	530.5	0.283E-00	100.00	0.6976E 06	0.1365E 01	0.293E-00
25	121.75	118.25	0.1736E 02	530.0	0.308E-00	100.00	0.7602E 06	0.1974E 01	0.326E-00
26	120.50	115.90	0.2122E 02	528.5	0.329E-00	100.00	0.8142E 06	0.2075E 01	0.355E-00
27	121.70	117.00	0.277E 02	528.5	0.347E-00	100.00	0.8565E 06	0.1903E 01	0.364E-00
28	120.20	109.70	0.2188E 02	528.5	0.361E-00	100.00	0.8922E 06	0.1597E 01	0.414E-00

D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 19
 RUN DATE DECEMBER 4, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

LOSS COEFFICIENT FOR DOME END BRG SHAFT FROM 10.1 TO 12.1. BASED ON 0.505 DIA AND FLOW AT 10.1

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.00	130.39	-0.3930E-00	530.0	0.995E-01	100.00	0.2454E 06	-0.4725E-00	0.955E-01
2	121.50	130.14	-0.7122E 00	527.0	0.130E-00	100.00	0.3213E 06	-0.5055E 00	0.124E-00
3	121.75	128.69	-0.9971E 00	525.5	0.153E-00	100.00	0.3797E 06	-0.5047E 00	0.148E-00
4	121.50	126.69	-0.1292E 01	524.0	0.172E-00	100.00	0.4275E 06	-0.5112E 00	0.169E-00
5	120.40	124.19	-0.1596E 01	523.0	0.188E-00	100.00	0.4690E 06	-0.5167E 00	0.189E-00
6	121.00	123.14	-0.1881E 01	523.0	0.201E-00	100.00	0.5005E 06	-0.5303E 00	0.203E-00
7	120.50	121.38	-0.2186E 01	527.0	0.214E-00	100.00	0.5299E 06	-0.5321E 00	0.220E-00
8	120.40	119.88	-0.2603E 01	525.5	0.226E-00	100.00	0.5613E 06	-0.5616E 00	0.235E-00
9	121.75	119.37	-0.2947E 01	525.5	0.237E-00	100.00	0.5883E 06	-0.5763E 00	0.247E-00
10	121.50	118.16	-0.3217E 01	524.5	0.246E-00	100.00	0.6107E 06	-0.5805E 00	0.259E-00
11	121.50	116.56	-0.3365E 01	524.5	0.255E-00	100.00	0.6342E 06	-0.5553E 00	0.273E-00
12	120.00	114.06	-0.3659E 01	524.5	0.264E-00	100.00	0.6551E 06	-0.5538E 00	0.288E-00
13	121.00	113.87	-0.3856E 01	524.5	0.272E-00	100.00	0.6766E 06	-0.5462E 00	0.298E-00
14	121.00	105.47	-0.5600E 01	522.5	0.314E-00	100.00	0.7831E 06	-0.5535E 00	0.370E-00
15	121.00	97.87	-0.7343E 01	522.5	0.344E-00	100.00	0.8560E 06	-0.5636E 00	0.436E-00
16	120.75	89.37	-0.9677E 01	522.5	0.367E-00	100.00	0.9137E 06	-0.5953E 00	0.510E 00
17	120.20	80.37	-0.1130E 02	522.5	0.383E-00	100.00	0.9542E 06	-0.5731E 00	0.592E 00

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04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 19
RUN DATE DECEMBER 4, 1963

NOZZLE END BEARING SHAFT

-NUMBER

4

-RING CLEARANCE (INCH)

0.2035

-PLENUM DEPTH (INCH)

0.3285

DRIVE SHAFT

-NUMBER

2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT FOR ORIFICE AND COUPLING FROM 10.1 TO 15.1. NO FLOW AREA DETERMINED.

	P1 PSI	PXA PSIA	DEL PXY PSID	TEMP DEG R	CLDASQ INCH-4	FLUX LB/SEC	PRCTW	REYN (10.1)
1	0.1200	0.1304	0.1226	530.0	0.2822	0.1137E-01	11.43	0.2454E 06
2	0.1215	0.1301	0.1965	527.0	0.2350	0.1586E-01	12.22	0.3213E 06
3	0.1217	0.1287	0.2849	525.5	0.1883	0.2115E-01	13.82	0.3797E 06
4	0.1215	0.1267	0.3733	524.0	0.2517	0.2081E-01	12.10	0.4275E 06
5	0.1214	0.1242	0.4765	523.0	0.2714	0.2244E-01	11.91	0.4690E 06
6	0.1210	0.1231	0.5059	523.0	0.3479	0.2033E-01	10.11	0.5005E 06
7	0.1205	0.1214	0.6140	527.0	0.3660	0.2160E-01	10.09	0.5299E 06
8	0.1204	0.1199	0.6140	525.5	0.2200	0.2773E-01	12.26	0.5613E 06
9	0.1217	0.1194	0.5403	525.5	0.6654	0.4719E-01	19.90	0.5883E 06
10	0.1215	0.1182	0.6484	524.5	0.9308	0.4353E-01	17.71	0.6107E 06
11	0.1215	0.1166	0.7957	524.5	0.2730	0.2797E-01	10.96	0.6342E 06
12	0.1200	0.1141	0.3596	524.5	0.2483	0.3015E-01	11.43	0.6551E 06
13	0.1210	0.1139	0.9971	524.5	0.4747	0.2346E-01	8.62	0.6766E 06
14	0.1210	0.1055	0.1449	522.5	0.2285	0.1243E-01	3.95	0.7831E 06
15	0.1210	0.9787	0.1842	522.5	0.1631	0.1598E-01	4.65	0.8560E 06
16	0.1207	0.8937	0.2210	522.5	0.8825	0.7192E-02	1.96	0.9137E 06
17	0.1202	0.8037	0.2554	522.5	0.6967	0.8251E-01	21.54	0.9542E 06

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04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 19
RUN DATE DECEMBER 4, 1963
NOZZLE END BEARING SHAFT
-NUMBER 4
-RING CLEARANCE (INCH) 0.2035
-PLENUM DEPTH (INCH) 0.3285
DRIVE SHAFT
-NUMBER 2
-DISCHARGE HOLE SIZE (INCH) 0.2500
FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
LOSS COEFFICIENT FOR COVE END COUPLING FROM 11.1 TO 15.1. NO FLOW AREA DETERMINED FOR SPLINES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	CLDASQ INCH-4	FLOW LB/SEC	PRCTW	REYN (10.1)
1	0.1200E 03	0.1294E 03	0.1130E-00	530.0	0.2576E 03	0.1147E-01	11.43	0.2454E 06
2	0.1215E 03	0.1294E 03	0.1817E-00	527.0	0.2142E 03	0.1586E-01	12.22	0.3213E 06
3	0.1217E 03	0.1281E 03	0.2210E-00	525.5	0.1611E 01	-0.2010E-00	131.35	0.3797E 06
4	0.1215E 03	0.1259E 03	0.3045E-00	524.0	0.2040E 03	0.2081E-01	12.10	0.4275E 06
5	0.1204E 03	0.1234E 03	0.3831E-00	523.0	0.2168E 03	0.2244E-01	11.91	0.4690E 06
6	0.1210E 03	0.1224E 03	0.4224E-00	523.0	0.2887E 03	0.2033E-01	10.11	0.5005E 06
7	0.1205E 03	0.1209E 03	0.5010E 00	527.0	0.2974E 03	0.2160E-01	10.09	0.5299E 06
8	0.1204E 03	0.1191E 03	0.5649E 00	525.5	0.2010E 03	0.2773E-01	12.26	0.5613E 06
9	0.1217E 03	0.1189E 03	0.5403E 00	525.5	0.6621E 02	0.4719E-01	19.90	0.5883E 06
10	0.1215E 03	0.1174E 03	0.5944E 00	524.5	0.8474E 02	0.4353E-01	17.71	0.6107E 06
11	0.1215E 03	0.1157E 03	0.7614E 00	524.5	0.2592E 03	0.2797E-01	10.96	0.6342E 06
12	0.1200E 03	0.1134E 03	0.8105E 00	524.5	0.2327E 03	0.3015E-01	11.43	0.6551E 06
13	0.1210E 03	0.1129E 03	0.8842E 00	524.5	0.4172E 03	0.2346E-01	8.62	0.6766E 06
14	0.1210E 03	0.1045E 03	0.1253E 01	522.5	0.1957E 04	0.1243E-01	3.95	0.7831E 06
15	0.1210E 03	0.9667E 02	0.1670E 01	522.5	0.1460E 04	0.1598E-01	4.65	0.8560E 06
16	0.1207E 03	0.8867E 02	0.2137E 01	522.5	0.8464E 04	0.7192E-02	1.96	0.9137E 06
17	0.1202E 03	0.7937E 02	0.2186E 01	522.5	0.5888E 02	0.8251E-01	21.54	0.9542E 06

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04.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 19
RUN DATE DECEMBER 4, 1963

NOZZLE END BEARING SHAFT

-NUMBER 4
-RING CLEARANCE (INCH) 0.2035
-PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT

-NUMBER 2

-DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE

LOSS COEFFICIENT IS FOR DRIVE SHAFT DISCHARGE HOLES (12.1 TO 15.1) AREA IS 0.19635.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	FLOW LB/SEC	PRCTW	REYN	COEFPL	MACH
1	120.00	130.59	0.5649E 00	530.0	0.861E-01	88.57	0.1097E 06	0.8341E 00	0.861E-01
2	121.50	130.59	0.7333E 00	527.0	0.921E-01	70.97	0.1151E 06	0.1269E 01	0.897E-01
3	121.75	129.39	0.1302E 01	525.5	0.101E-00	66.04	0.1265E 06	0.1461E 01	0.992E-01
4	121.50	127.59	0.1449E 01	524.0	0.121E-00	70.08	0.1512E 06	0.1131E 01	0.120E-00
5	120.4	125.39	0.2083E 01	523.0	0.129E-00	68.29	0.1617E 06	0.1407E 01	0.130E-00
6	121.00	124.59	0.2407E 01	523.0	0.143E-00	71.37	0.1803E 06	0.1296E 01	0.146E-00
7	120.50	123.38	0.2800E 01	527.0	0.150E-00	69.97	0.1871E 06	0.1361E 01	0.154E-00
8	120.40	121.99	0.3242E 01	525.5	0.156E-00	68.94	0.1953E 06	0.1440E 01	0.162E-00
9	121.75	121.87	0.3512E 01	525.5	0.145E-00	61.25	0.1819E 06	0.1798E 01	0.151E-00
10	121.50	120.86	0.3856E 01	524.5	0.155E-00	62.98	0.1941E 06	0.1726E 01	0.163E-00
11	121.50	119.56	0.4273E 01	524.5	0.178E-00	69.82	0.2235E 06	0.1428E 01	0.189E-00
12	120.00	117.11	0.4544E 01	524.5	0.184E-00	69.89	0.2311E 06	0.1390E 01	0.200E-00
13	121.00	117.12	0.4838E 01	524.5	0.199E-00	72.91	0.2490E 06	0.1276E 01	0.215E-00
14	121.00	110.77	0.7024E 01	522.5	0.246E-00	78.21	0.3091E 06	0.1147E 01	0.281E-00
15	121.00	104.67	0.9210E 01	522.5	0.264E-00	76.92	0.3324E 06	0.1229E 01	0.320E-00
16	120.75	99.12	0.1189E 02	522.5	0.295E-00	80.47	0.3711E 06	0.1205E 01	0.377E-00
17	120.20	91.87	0.1393E 02	522.5	0.237E-00	61.85	0.2979E 06	0.2030E 01	0.327E-00

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D4.1 CONTROL DRUM - DRIVE SHAFT LOSS COEFFICIENTS

BUILD NUMBER 19
 RUN DATE DECEMBER 4, 1963

NOZZLE END BEARING SHAFT
 -NUMBER 4
 -RING CLEARANCE (INCH) 0.2035
 -PLENUM DEPTH (INCH) 0.3285

DRIVE SHAFT
 -NUMBER 2
 -DISCHARGE HOLE SIZE (INCH) 0.2500

FLUID IS COMPRESSED AIR AT AMBIENT TEMPERATURE
 LOSS COEFFICIENT IS FOR ACTUATOR END COUPLING FROM 19.1 TO 16.1. NO AREA DETERMINED FOR SPLINES.

	P1 PSIG	PXA PSIA	DELPHY PSID	TEMP DEG R	CLDASQ INCH-4	FLOW LB/SEC	PRCTW	REYN (10.1)
1	0.1200E 03	0.1309E 03	0.7221E 00	530.0	0.	0.	0.	0.2454E 06
2	0.1215E 03	0.1314E 03	0.1208E 01	527.0	0.7648E 03	0.2181E-01	16.81	0.3213E 06
3	0.1217E 03	0.1306E 03	0.1680E 01	525.5	0.5306E 03	0.3082E-01	20.14	0.3797E 06
4	0.1215E 03	0.1287E 03	0.2161E 01	524.0	0.6826E 03	0.3064E-01	17.82	0.4275E 06
5	0.1204E 03	0.1267E 03	0.2652E 01	523.0	0.5574E 03	0.3731E-01	19.80	0.4690E 06
6	0.1210E 03	0.1261E 03	0.3134E 01	523.0	0.6585E 03	0.3722E-01	18.51	0.5005E 06
7	0.1205E 03	0.1249E 03	0.3512E 01	527.0	0.5524E 03	0.4265E-01	19.93	0.5299E 06
8	0.1204E 03	0.1239E 03	0.4052E 01	525.5	0.6374E 03	0.4254E-01	18.80	0.5613E 06
9	0.1217E 03	0.1241E 03	0.4519E 01	525.5	0.6457E 03	0.4468E-01	18.84	0.5883E 06
10	0.1215E 03	0.1230E 03	0.4937E 01	524.5	0.6199E 03	0.4748E-01	19.32	0.6107E 06
11	0.1215E 03	0.1216E 03	0.5354E 01	524.5	0.6051E 03	0.4976E-01	19.49	0.6342E 06
12	0.1200E 03	0.1191E 03	0.5772E 01	524.5	0.6523E 03	0.4925E-01	18.68	0.6551E 06
13	0.1210E 03	0.1189E 03	0.6199E 01	524.5	0.6700E 03	0.5032E-01	18.48	0.6766E 06
14	0.1210E 03	0.1134E 03	0.8989E 01	522.5	0.7488E 03	0.5608E-01	17.84	0.7831E 06
15	0.1210E 03	0.1079E 03	0.1159E 02	522.5	0.7207E 03	0.6332E-01	18.43	0.8560E 06
16	0.1207E 03	0.1014E 03	0.1378E 02	522.5	0.7771E 03	0.6444E-01	17.57	0.9137E 06
	0.1202E 03	0.9437E 02	0.1591E 02	522.5	0.8578E 03	0.6361E-01	16.61	0.9542E 06