

UNANNOUNCED

AD-A956 154



DTIC
ELECTE
FEB 16 1993
S C D

DETERMINATION OF DISCHARGE
AND THRUST COEFFICIENTS OF A
CHOKED ASME NOZZLE FROM
EXIT FLOW SURVEYS
(ADDITIONAL TESTS)

by

James S. Holdhusen
Donald Perusse

Conducted for
General Electric Company
Cincinnati, Ohio

G. E. Purchase Order No. 200G230285
FluidDyne Project 0470
September 1965

Approved by:

James L. Grunnet
James L. Grunnet
Project Engineer

DISTRIBUTION STATEMENT A

Approved for public release
Distribution Unlimited

Nicholas C. Helm
Nicholas C. Helm
Program Planner

Owen P. Lamb
Owen P. Lamb
Program Manager

93-02792

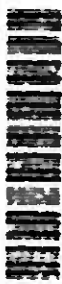


TABLE OF CONTENTS

	<u>Page</u>
DEFINITION OF SYMBOLS.	ii
LIST OF TABLES AND FIGURES	iv
INTRODUCTION	1
CONCLUSIONS.	2
DISCUSSION	3

TABLES

FIGURES

DATA SHEETS

DTIC QUALITY INSPECTED 3

Accession For	
NTIS CRA&I	☒
DTIC TAB	☐
Unannounced	☒
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and for Special
A-1	

DEFINITION OF SYMBOLS

A	Local Area	square feet
A_e	Nozzle Exit Area	square feet
a	Local Speed of Sound	feet/second
C_D	Discharge Coefficient	
C_s	Stream Thrust Coefficient	
C_v	Thrust Coefficient Calculated Using p_s at Nozzle Exit	
F	Nozzle Exit Stream Thrust	pounds
G	Exhaust Thrust ($F - p_a A_e$)	pounds
M	Mach Number	
$\dot{m}$	Mass Flow	slugs/second
p_a	Static Pressure in Plenum Around Nozzle Exit	psfa
p_s	Static Pressure Inside Nozzle at the Exit	psfa
p_o	Total Pressure	psfa
p	Static Pressure	psfa
P_r	Prandtl Number	
R	Gas Constant for Air	53.35 feet/ $^{\circ}$ R
T	Static Temperature	$^{\circ}$ R
T_{aw}	Adiabatic Wall Temperature	$^{\circ}$ R
T_o	Total Temperature	$^{\circ}$ R
V	Velocity	feet/second
β	Ratio of Exit to Entrance Diameter of Nozzle	

FLUIDDYNE ENGINEERING CORPORATION

γ	Ratio of Specific Heats (C_p/C_v)	
λ	Pressure Ratio (p_o/p_a)	
ρ	Mass Density	slugs/feet ³

SUBSCRIPTS

act	Actual
l	Ideal Based on Ambient Conditions
i	Ideal Based on Exit Static Conditions

LIST OF TABLES AND FIGURES

TABLE I.	Tabulated Test Results
TABLE II.	Dimensionless Static Pressure Distributions

<u>FIGURE</u>	<u>DESCRIPTION</u>
1.	ASME Flow Nozzle Installation
2.	Static Pressure Distributions
3.	Ratio of Nozzle Static to Ambient Pressure
4.	Ratio of Nozzle Static to Ambient Pressure - Expanded Scale
5.	Discharge Coefficient Versus Nozzle Pressure Ratio
6.	Discharge Coefficient Versus Throat Reynolds Number
7.	Thrust Coefficient Versus Nozzle Pressure Ratio
8.	Thrust Coefficient Versus Throat Reynolds Number
9-42.	Integrand Calculations and Plots

I. INTRODUCTION

This study, sponsored by the General Electric Company under their Purchase Order Number 200G230085, determined the discharge and velocity coefficients of an ASME long radius metering nozzle. Previous tests of this nozzle (Reference 1) had been conducted with an exhaustor system which permitted operation at variable pressure ratio while keeping the Reynolds number constant. These additional tests were conducted to determine:

- A. Whether the presence of the exhaustor duct or the survey rake significantly affected the integrated data.
- B. The effect of further changes of operating pressure ratio in the lower ranges of pressure ratio.
- C. The effect of decreasing the Reynolds number.

II. CONCLUSIONS

- A. These tests confirmed the observation made in the preceding test program (0431, Reference 1) that the core survey rake caused a consistent and appreciable increase in the measured static pressure, p_s , inside the nozzle near the exit. It may be concluded that this effect is present whether or not the exit plenum is installed. The effect is probably a manifestation of the sensitivity of transonic flow to small amounts of blockage, since the measured increase in pressure became greater as the pressure ratio approached the critical (choking) value.
- B. The nozzle discharge coefficient showed an increasing trend with Reynolds number, varying from 0.989 at $Re = 10^6$ to 0.992 at $Re = 10^7$. The nozzle pressure ratio showed no consistent, independent effect on the discharge coefficient.
- C. The nozzle thrust coefficient (at pressure ratios less than critical) also showed an increasing trend with Reynolds number, varying from 0.992 at $Re = 10^6$ to 0.995 at $Re = 6 \times 10^6$.

III. DISCUSSION

In the previous study conducted by FluidDyne, discharge and thrust coefficients were determined for a 7.715 inch diameter ASME long radius nozzle. The nozzle for these tests discharged into a cylindrical plenum in which pressure could be controlled by ejectors to vary the pressure ratio. The total pressure was held constant for most of the runs, giving a fairly constant throat Reynolds number.

For this test program, the metering nozzle discharged to atmosphere to eliminate any effects that might have been caused by the plenum on the first test series. Discharging to atmosphere meant that the nozzle pressure ratio and throat Reynolds number were controlled by the nozzle total pressure. Discharge and thrust coefficients were obtained over a pressure ratio range of 1.03 to 3.93 which corresponds to a Reynolds number variation of 0.95×10^6 to 12.0×10^6 .

The nozzle instrumentation was the same as for the previous test program except that the total pressure cross-rake, used to survey the core flow at the exit of the nozzle, was only installed on four runs. These four runs were made to determine the effect of the cross-rake on the static pressure near the nozzle exit. Mercury and water manometers were used for all pressure measurements.

The data reduction procedures used for these data were the same as described in the report for Project 0431. The calculations and plots of the integrands of the discharge and thrust coefficient equations are

shown in Figures 9 to 42. The tabulated test results are presented as Table I.

A plot of typical static pressure distributions through the nozzle is presented as Figure 2. A tabulation of these same typical static pressures is presented as Table II. The ratio of nozzle static to ambient pressure (P_s/P_a) is plotted versus nozzle pressure ratio for each data point of the two test programs and presented in Figure 3. Both sets of data closely follow the ideal curve for pressure ratios greater than two. For pressure ratios less than two, the data points taken on the 0431 program and the data points with the exit cross-rake installed on the 0470 program have a P_s/P_a ratio slightly higher than the ideal curve. The ratio of P_s/P_a in this lower pressure ratio range is presented as an expanded portion of the curve as Figure 4.

The nozzle discharge coefficients plotted versus nozzle pressure ratio and Reynolds number are presented as Figures 5 and 6, respectively. The discharge coefficients obtained in the previous study are also presented in these plots. The discharge coefficients obtained in the two test programs agree when compared on a throat Reynolds number basis, as would be expected from similitude considerations.

The two sets of thrust coefficient data, plotted versus nozzle pressure ratio, are presented as Figure 7. The same thrust coefficient data, obtained at pressure ratios equal to or less than two, are plotted

versus Reynolds number and presented as Figure 8. Good agreement is obtained between these two sets of data when compared at like pressure ratios. Good agreement is also obtained when compared on a Reynolds number basis.

-
- Reference 1. "Determination of Discharge and Thrust Coefficients of a Choked ASME Nozzle from Exit Flow Surveys," James S. Holdhusen and Charles L. Landgraf, Fluidyne Project 0431, February 1965.

TABLE 1 TABULATED TEST RESULTS

Data Point	Press. Ratio	Po (psia)	Pa (psia)	Pa/Po	$\int \frac{M}{\sqrt{g}} \sqrt{\frac{T_1}{T}} \frac{dA}{A}$	$\left(\int \frac{M}{\sqrt{g}} \right)^2 \frac{dA}{A^2}$	C _D	C _T	C _s	Thrt. Re x 10 ⁻⁶
1	1.209	17.23	14.29	1.0031	.9902	.9829	.9902	.9927	1.1541	2.54
2	2.408	35.20	18.21	1.2779	.9923	.9874	.9923	.9952	1.2689	7.47
3	1.418	20.14	14.28	1.0052	.9905	.9840	.9905	.9953	1.2248	3.62
4	1.643	23.34	14.32	1.0079	.9905	.9851	.9905	.9948	1.2592	4.66
5	1.857	26.37	14.45	1.0176	.9915	.9865	.9915	.9952	1.2683	5.60
6	2.059	29.25	15.41	1.0848	.9921	.9869	.9921	.9953	1.2682	6.19
8	2.276	32.23	16.79	1.1860	.9924	.9879	.9924	.9968	1.2704	6.83
9	2.487	35.21	18.35	1.2959	.9925	.9880	.9925	.9953	1.2680	7.47
10	2.710	38.37	20.02	1.4141	.9925	.9876	.9925	.9941	1.2683	8.15
11	2.904	41.05	21.27	1.5052	.9923	.9878	.9923	.9918	1.2683	8.70
12	3.120	44.09	22.88	1.6193	.9925	.9880	.9925	.9888	1.2704	9.44
13	3.355	47.20	24.57	1.7491	.9925	.9883	.9925	.9880	1.2686	10.0
14	3.568	50.10	26.11	1.8602	.9924	.9880	.9924	.9875	1.2678	10.6
15	3.773	52.96	27.60	1.9662	.9926	.9880	.9926	.9838	1.2681	11.2
16a	3.985	55.93	29.27	2.0854	.9930	.9885	.9930	.9819	1.2683	12.0
16b	3.929	55.13	28.75	2.0513	.9924	.9878	.9924	.9829	1.2683	11.3
17	1.219	17.12	14.07	1.0021	.9903	.9836	.9903	.9929	1.1593	2.52
18	1.431	20.09	14.10	1.0045	.9911	.9853	.9911	.9938	1.2283	3.62
19	1.647	23.13	14.13	1.0066	.9912	.9855	.9912	.9939	1.2592	4.60
20	1.613	23.14	14.13	1.0063	.9903	.9840	.9903	.9936	1.2587	4.60
21	1.859	26.10	14.28	1.0171	.9917	.9870	.9917	.9954	1.2684	5.54
22	2.066	29.00	15.25	1.0861	.9922	.9876	.9922	.9937	1.2683	6.15
23	2.073	29.11	15.27	1.0875	.9923	.9876	.9923	.9957	1.2711	6.17
24	1.213	17.10	14.14	1.0035	.9908	.9843	.9908	.9939	1.1554	2.53
25	1.647	23.21	14.18	1.0278	.9918	.9864	.9918	.9950	1.2557	4.62
26	2.498	35.20	18.85	1.3373	.9928	.9879	.9928	.9953	1.2681	7.49
27	2.488	35.07	18.81	1.3348	.9925	.9878	.9925	.9955	1.2684	7.43
28	3.128	44.13	22.94	1.6260	.9927	.9882	.9927	.9895	1.2681	8.15
29	3.136	44.24	23.02	1.6319	.9928	.9882	.9928	.9903	1.2679	9.12
2-1	1.032	14.885	14.228	1.00007	.9893	.9815	.9893	.9921	1.0402	0.94
2-2	1.053	14.930	14.229	1.00010	.9900	.9818	.9900	.9917	1.0571	1.25
2-3	1.106	15.738	14.229	1.00012	.9898	.9818	.9898	.9919	1.0968	1.73
2-4	1.152	16.397	14.231	1.00027	.9897	.9827	.9897	.9929	1.1261	2.11
2-5	1.202	17.099	14.232	1.00033	.9900	.9835	.9900	.9934	1.1523	2.42

TABLE II
DIMENSIONLESS STATIC PRESSURE DISTRIBUTIONS
(P/Po)

Run Number	Press. Ratio $\lambda = \frac{P_o}{P_a}$	$\frac{P_a}{P_o}$ $\frac{1}{\lambda}$	Values of P/Po									
			Tap Numbers									
			1-4*	5	6	7	8	9	10	11	12	
1	1.209	.8271	.8295	.8310	.8324	.8310	.8239	.8197	.8182	.8011	.8410	
3	1.418	.7052	.7088	.7125	.7161	.7125	.7003	.6930	.6930	.7015	.7477	
4	1.643	.6086	.6135	.6169	.6232	.6211	.6065	.5971	.5950	.6191	.6943	
5	1.857	.5385	.5481	.5609	.5702	.5729	.5609	.5488	.5479	.5896	.6787	
6	2.059	.4857	.5269	.5477	.5611	.5661	.5544	.5419	.5419	.5879	.6791	
8	2.276	.4394	.5212	.5473	.5587	.5632	.5518	.5397	.5397	.5860	.6764	
9	2.487	.4021	.5211	.5453	.5599	.5641	.5522	.5404	.5404	.5863	.6780	
11	2.904	.3444	.5184	.5441	.5572	.5626	.5501	.5382	.5388	.5853	.6783	
14	3.568	.2803	.5213	.5445	.5582	.5636	.5504	.5387	.5387	.5856	.6774	
16b	3.929	.2545	.5222	.5453	.5591	.5640	.5502	.5391	.5387	.5857	.6794	

*Average

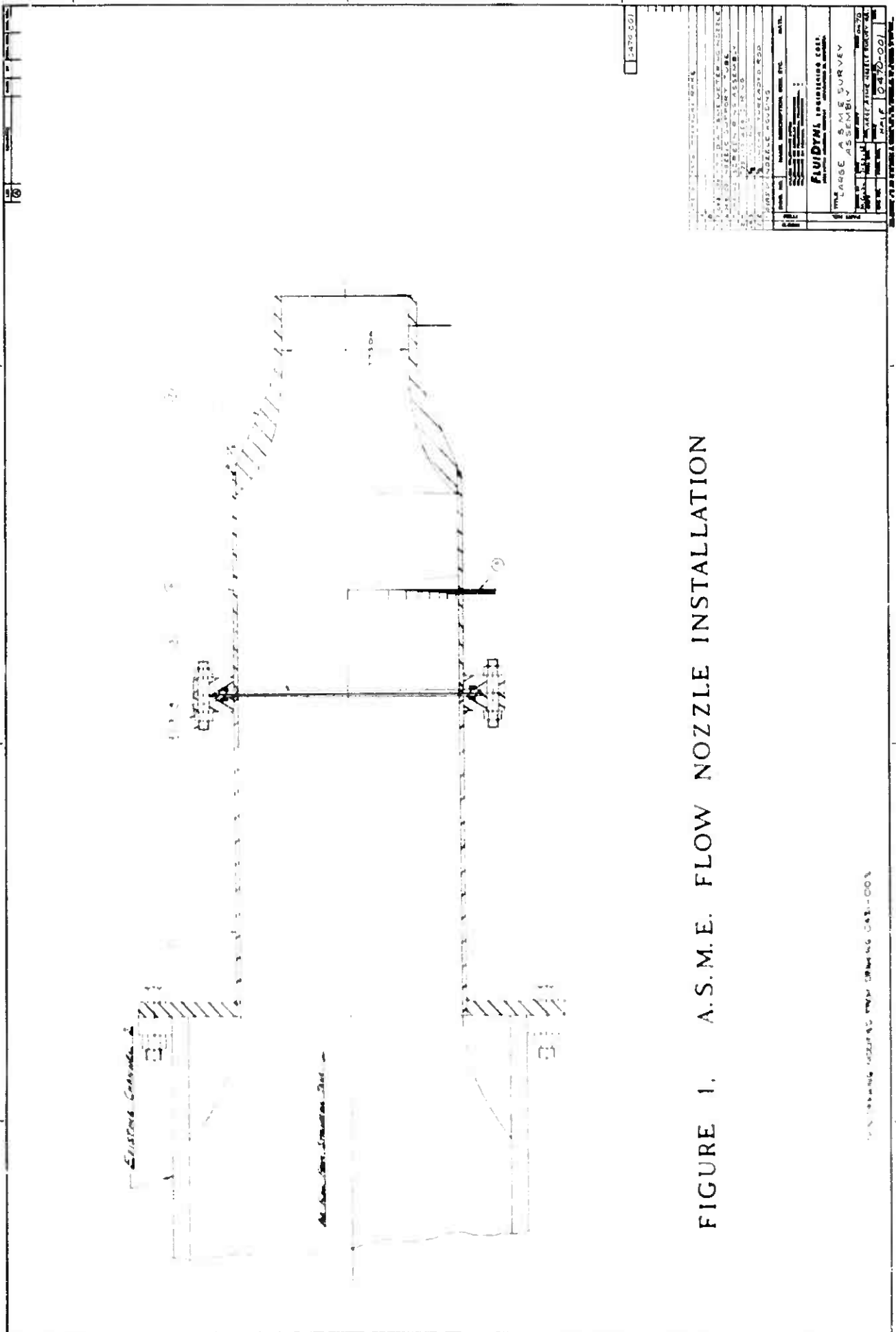


FIGURE 1. A.S.M.E. FLOW NOZZLE INSTALLATION

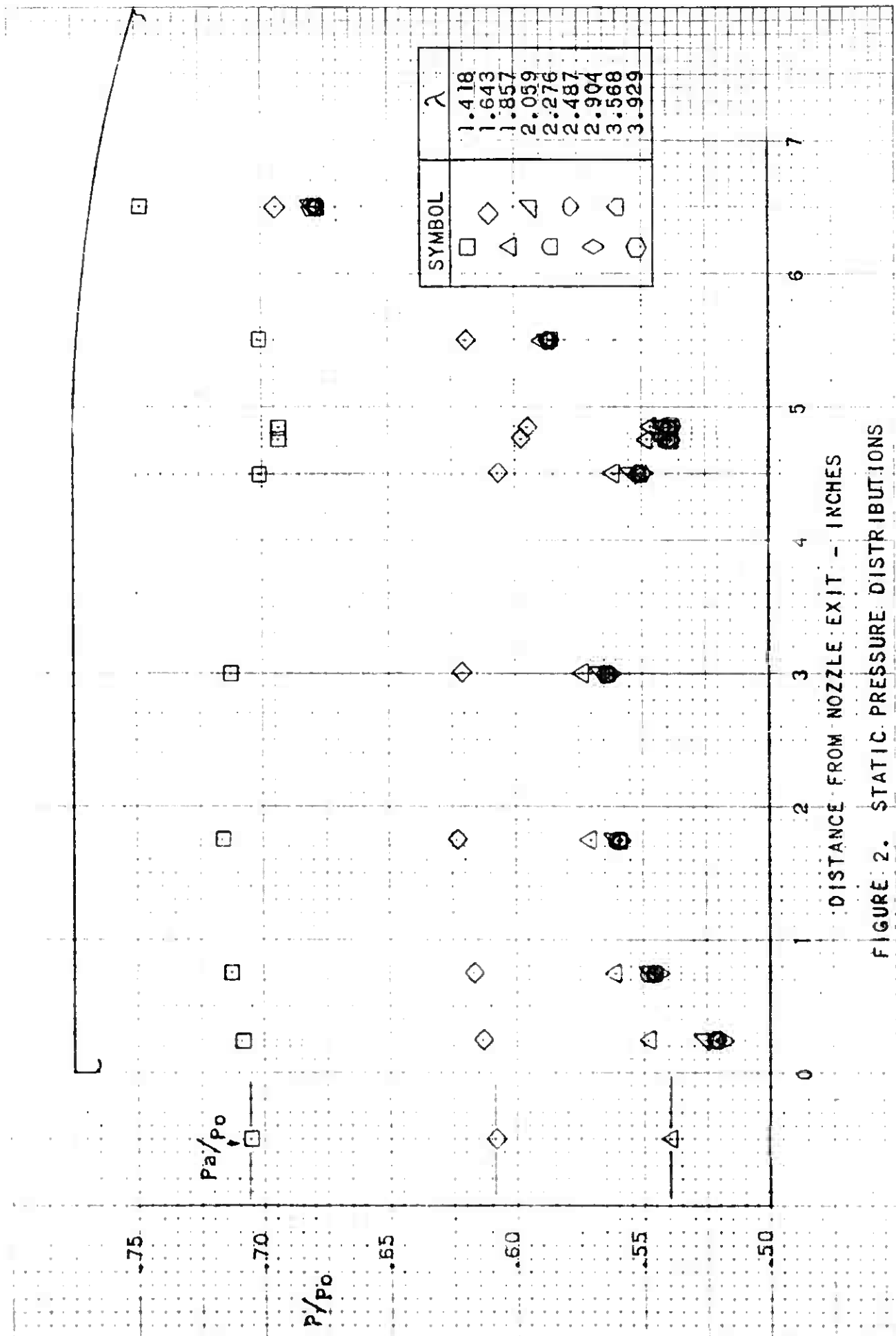


FIGURE 2. STATIC PRESSURE DISTRIBUTIONS

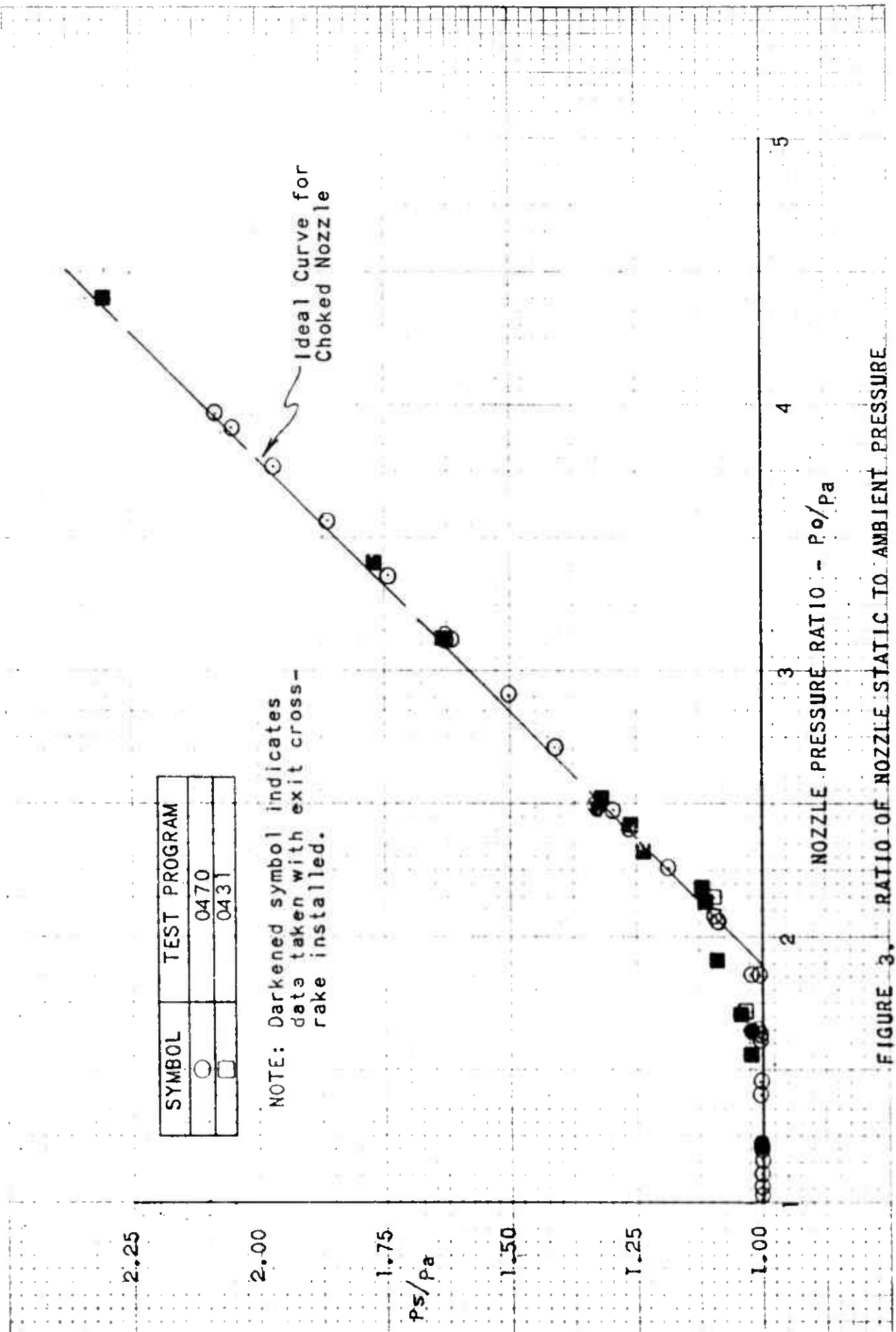


FIGURE 3. RATIO OF NOZZLE STATIC TO AMBIENT PRESSURE

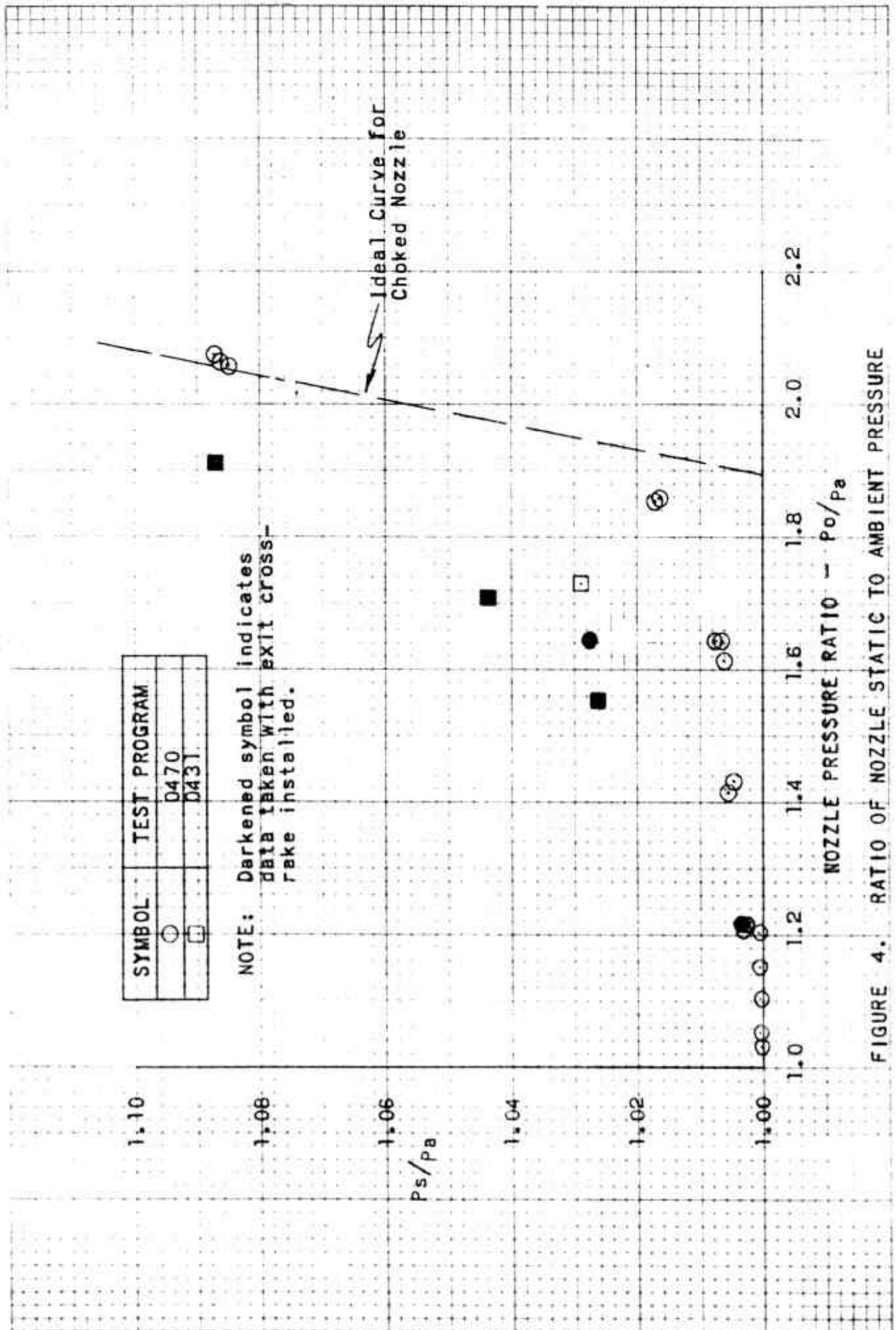


FIGURE 4. RATIO OF NOZZLE STATIC TO AMBIENT PRESSURE

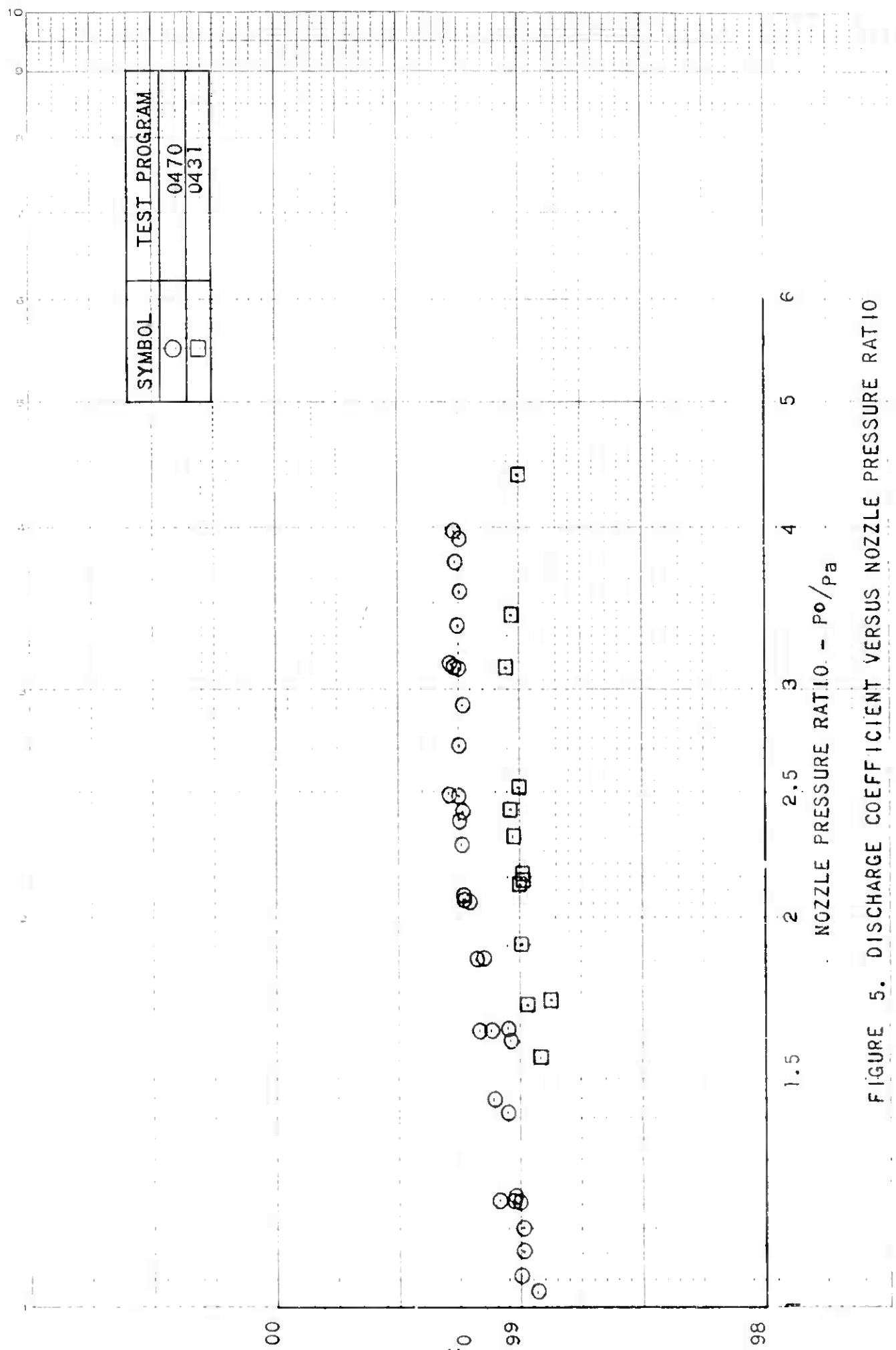


FIGURE 5. DISCHARGE COEFFICIENT VERSUS NOZZLE PRESSURE RATIO

SYMBOL	TEST PROGRAM
○	0470
□	0431

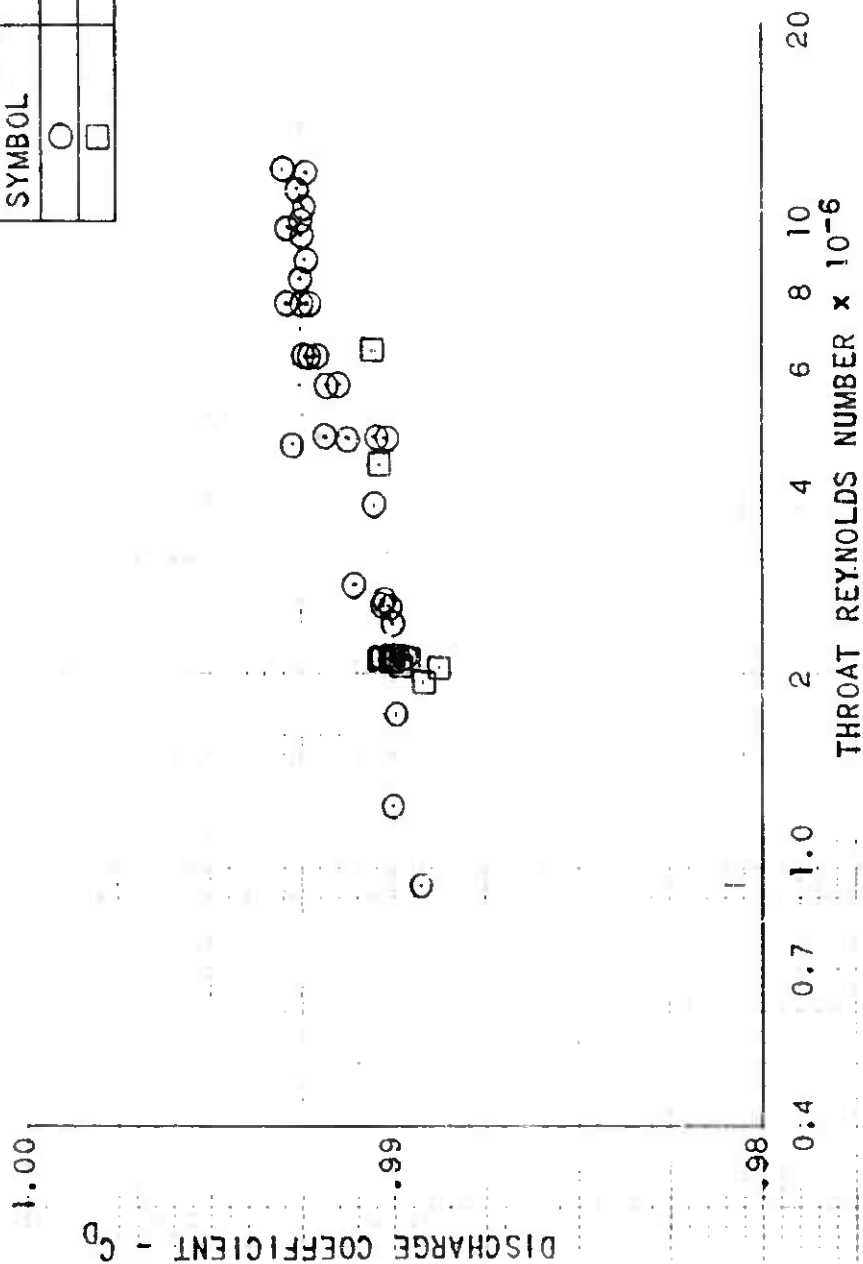


FIGURE 6. DISCHARGE COEFFICIENT VERSUS THROAT REYNOLDS NUMBER

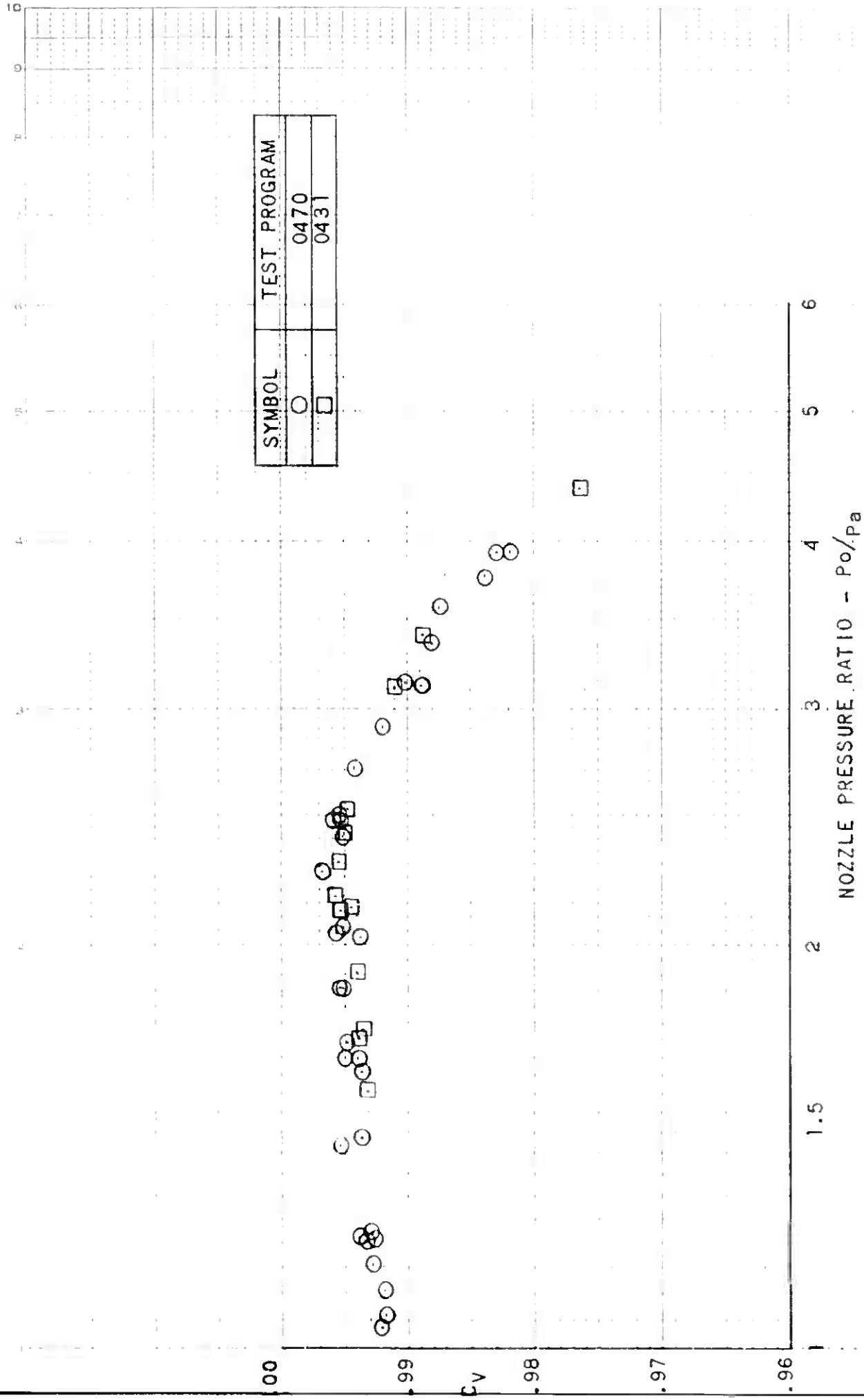


FIGURE 7. THRUST COEFFICIENT VERSUS NOZZLE PRESSURE RATIO

SYMBOL	TEST PROGRAM
○	0470
□	0431

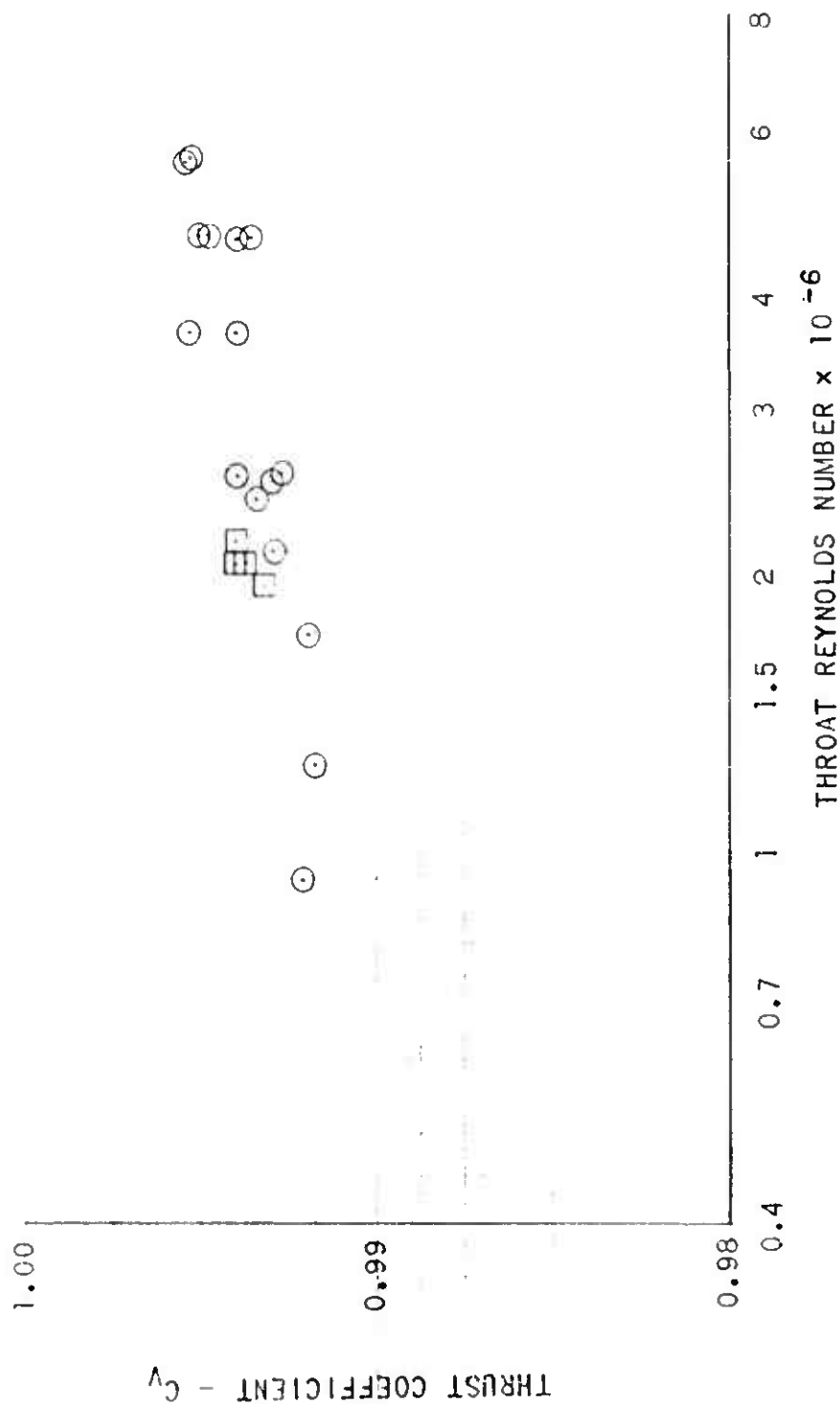


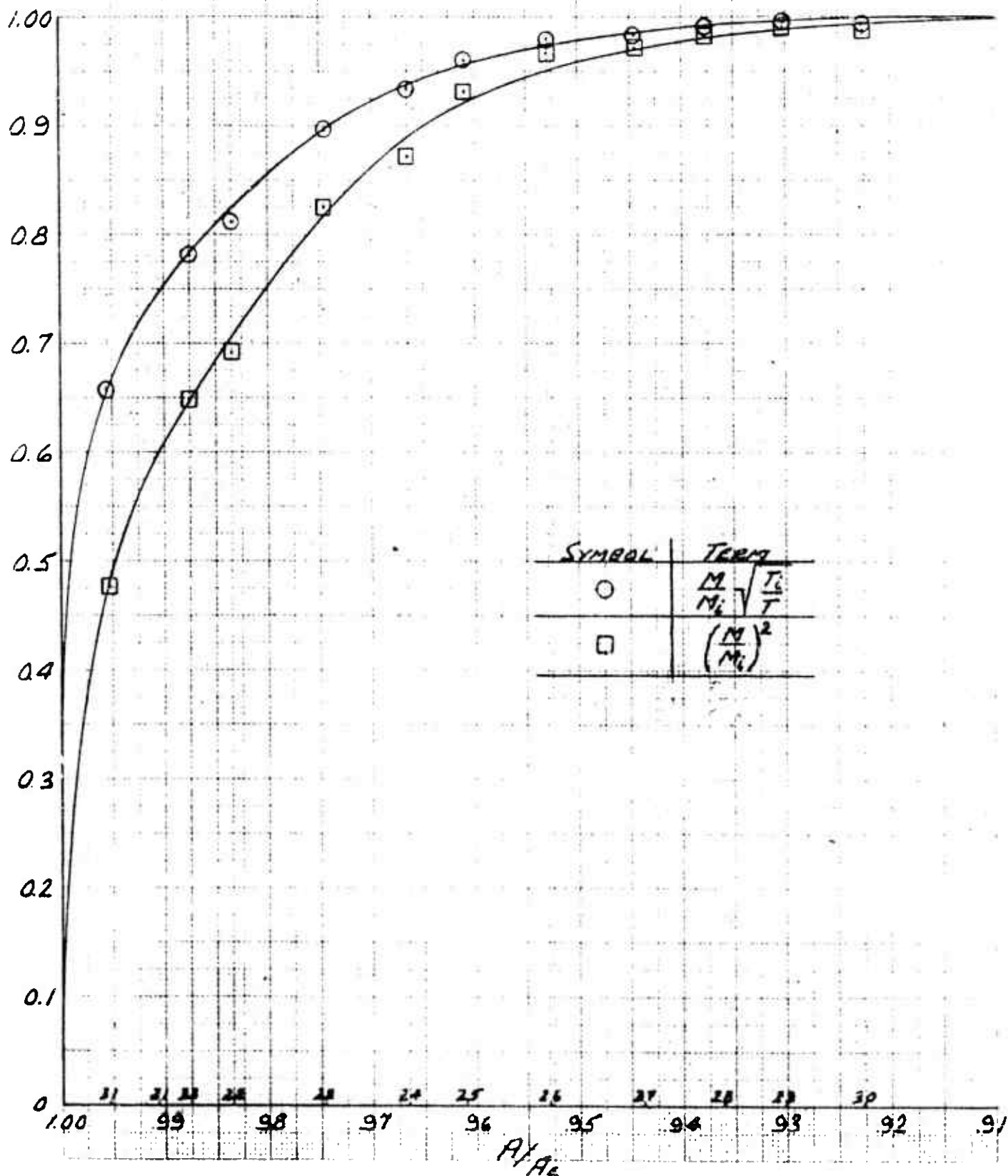
FIGURE 8. THRUST COEFFICIENT VERSUS THROAT REYNOLDS NUMBER

FLUIDDYNE ENGINEERING CORPORATION

INTEGRATION CURVES

TO DETERMINE CO F. CY

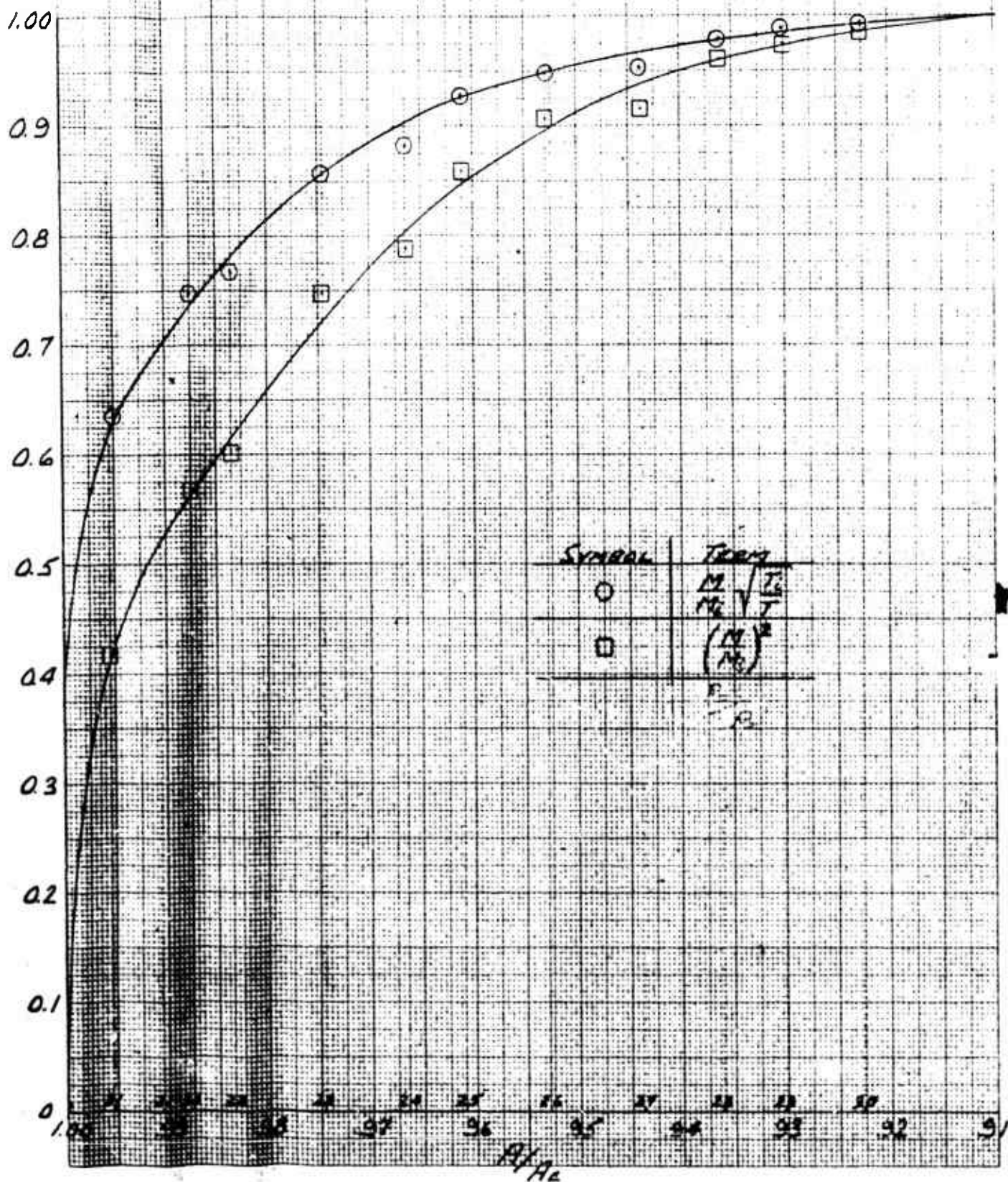
RUN 2 DATA POINT 2.4706



2556
2066

INTEGRATION CURVES
TO DETERMINE C_D & C_v

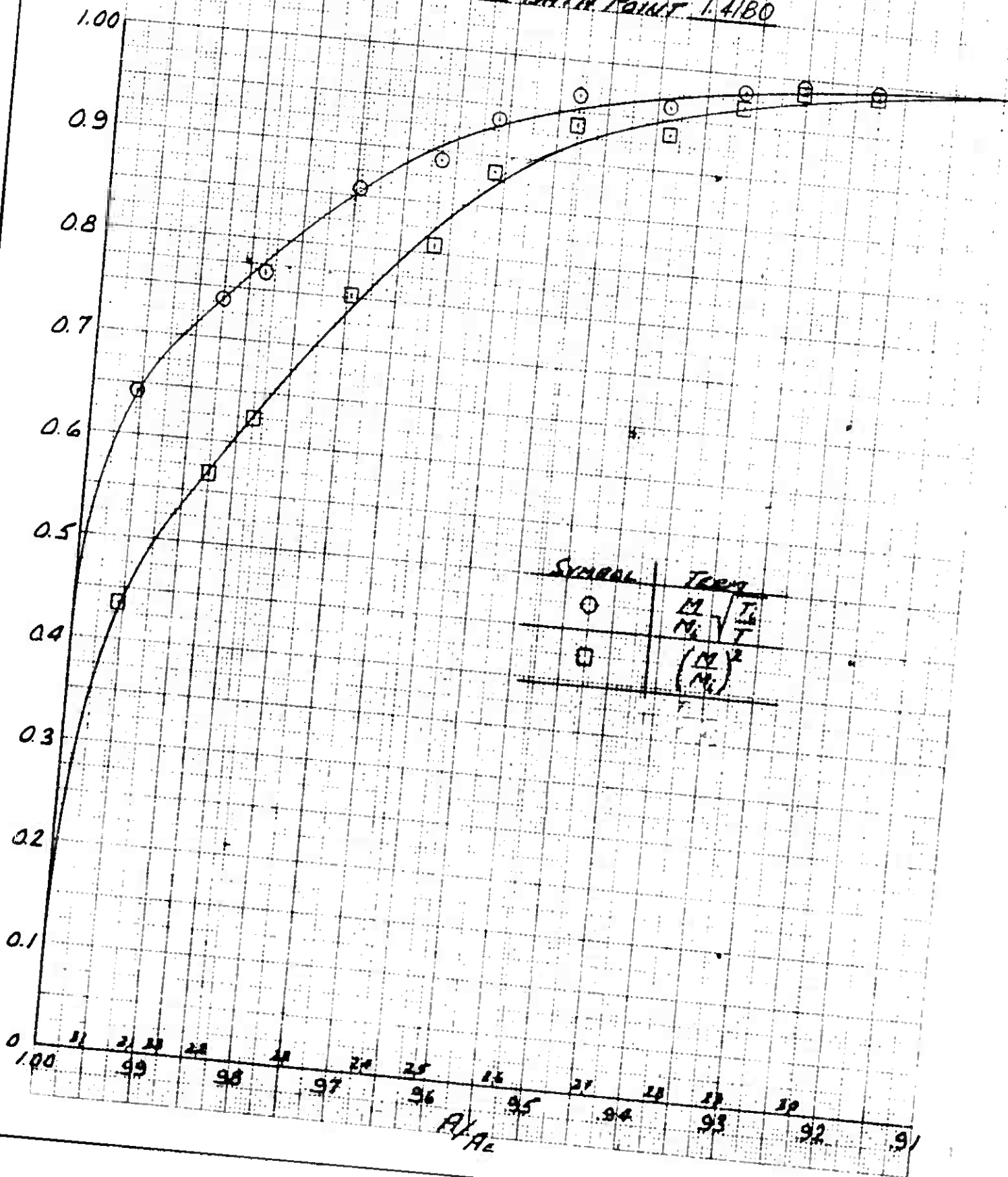
RUN 1 DATA POINT 1.2092



0786
5065

FLUIDYNE ENGINEERING CORPORATION

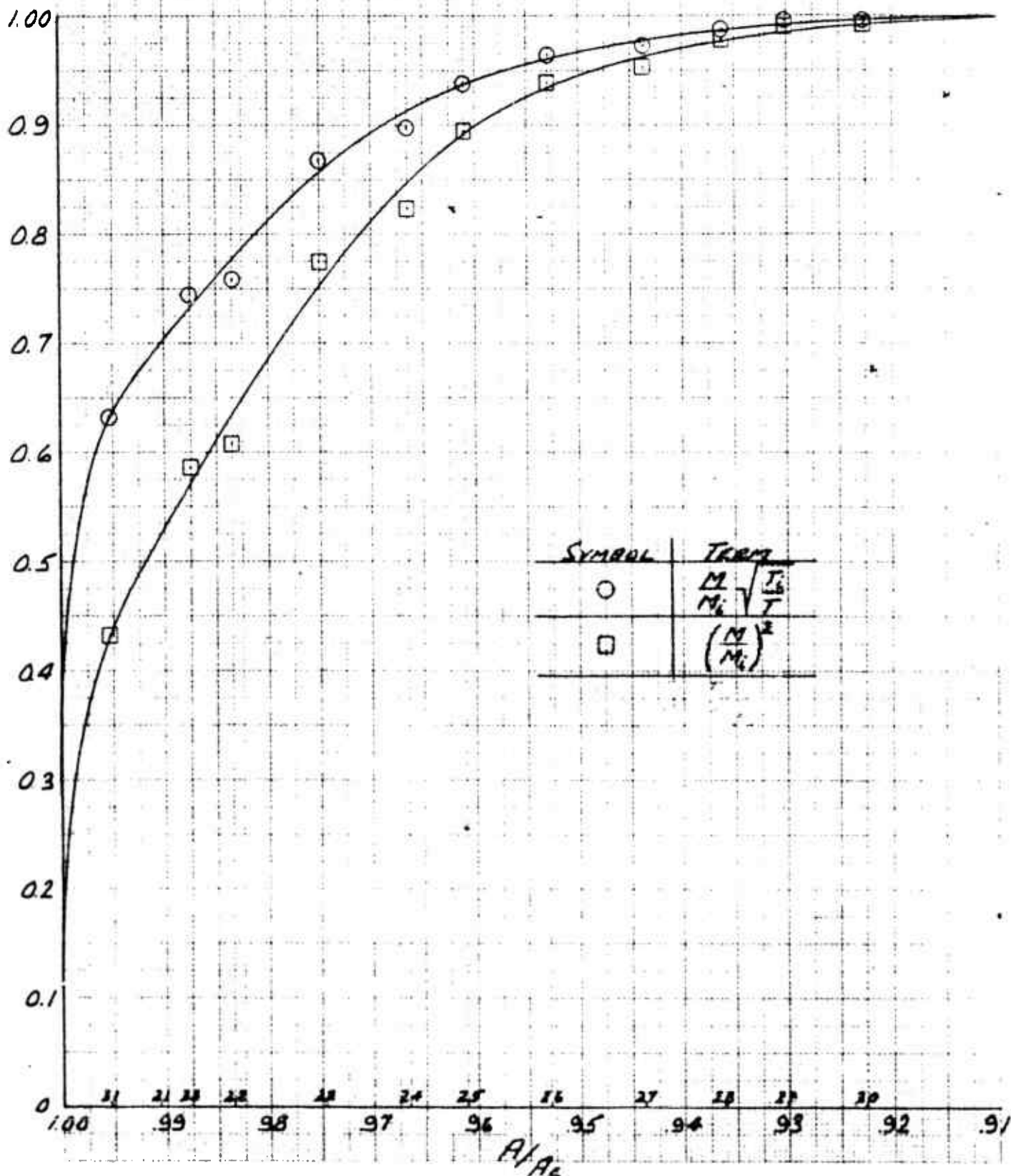
INTEGRATION CURVES
TO DETERMINE C_D & C_X
RUN 3 DATA POINT 1.4180



1536
5066

FLUIDDYNE ENGINEERING CORPORATION

INTEGRATION CURVES
TO DETERMINE C_D & C_v
 RUN 4 DATA POINT 1.6430

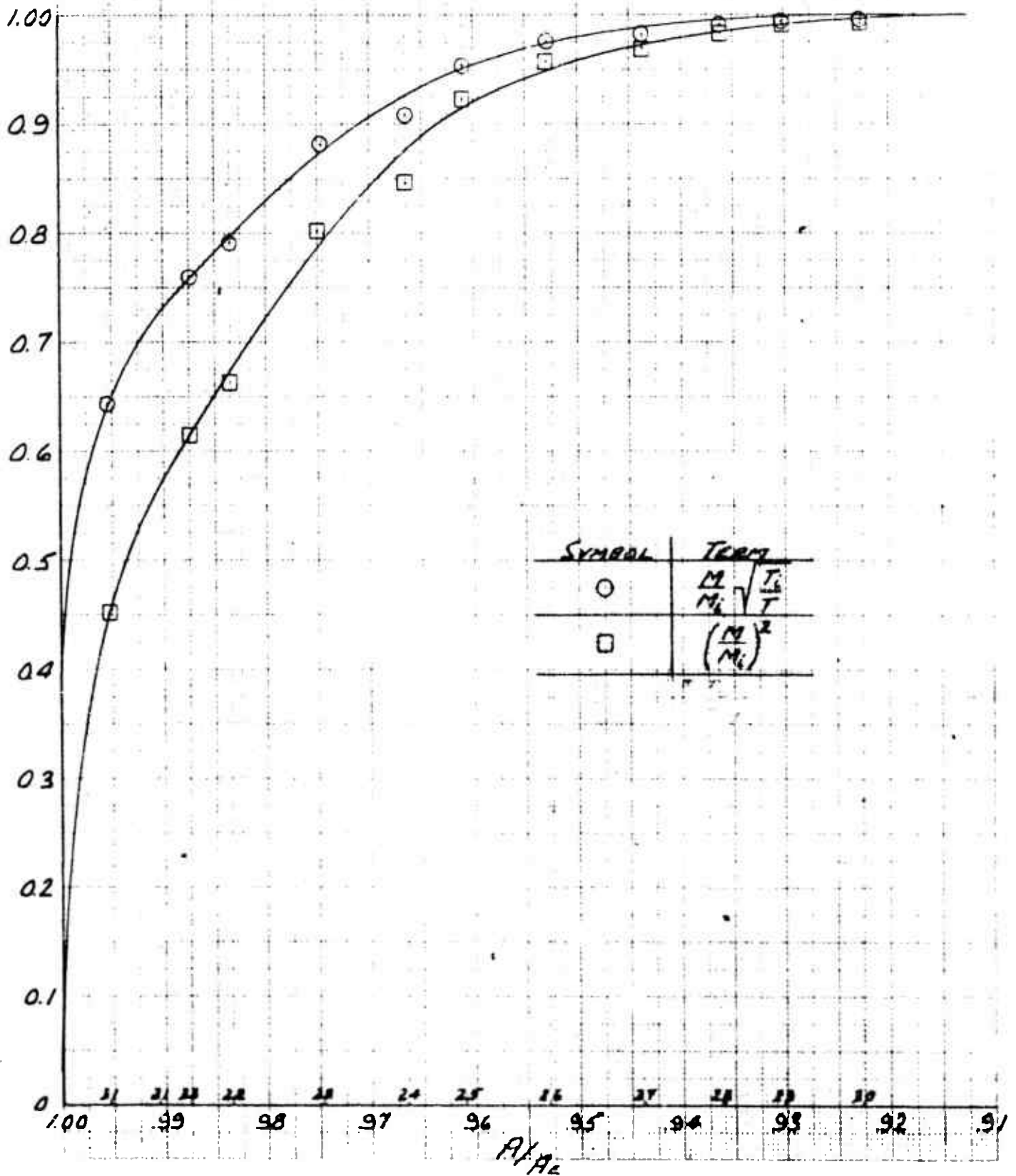


FLUIDDYNE ENGINEERING CORPORATION

573 b
5166

INTEGRATION CURVES TO DETERMINE C_D & C_V

RUN 5 DATA POINT 1.8567

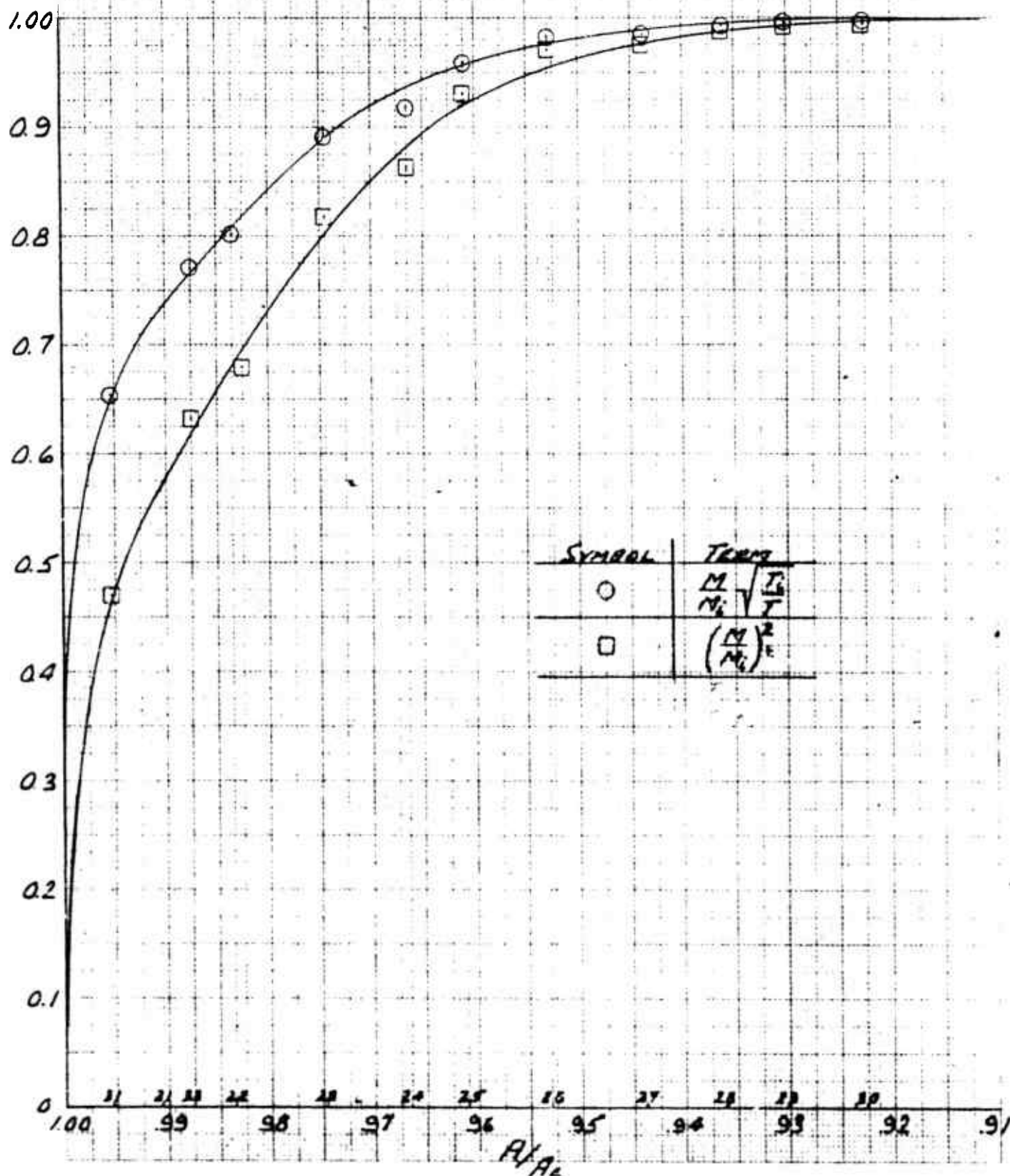


FLUIDDYNE ENGINEERING CORPORATION

h98b
1c6b

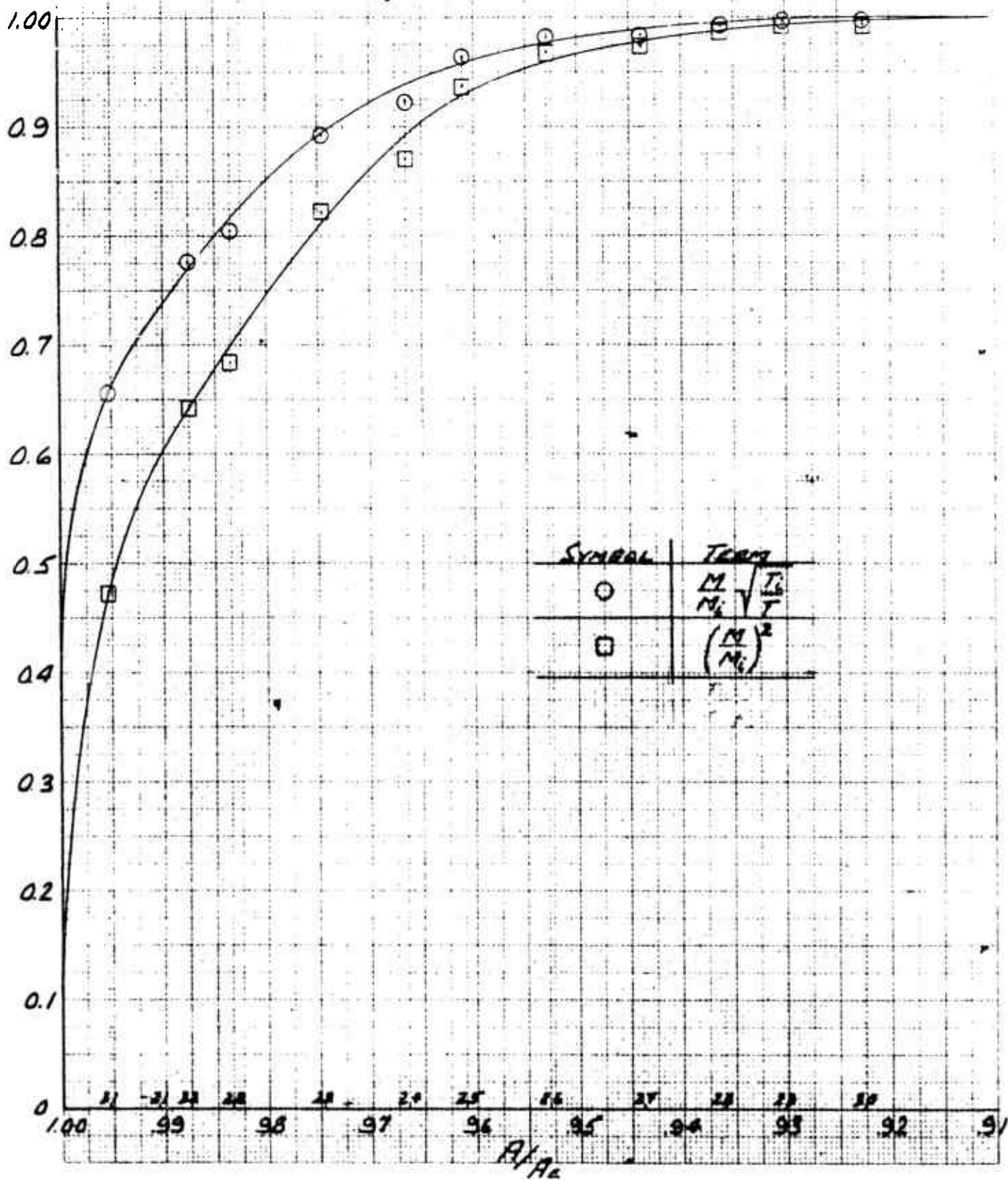
INTEGRATION CURVES TO DETERMINE C_D & C_v

RUN 6 DATA POINT 2.0589



9686
1266

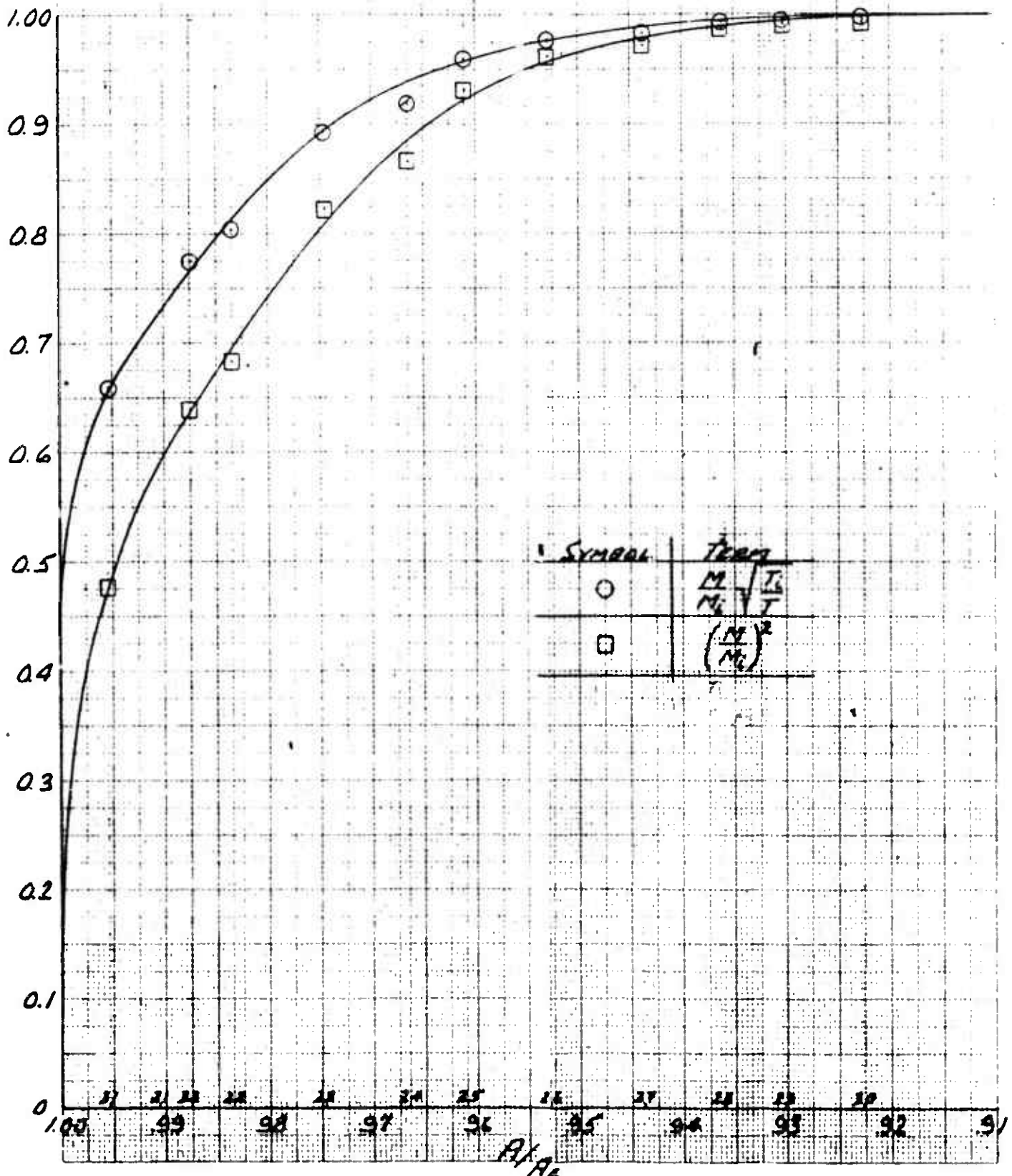
INTEGRATION CURVES
TO DETERMINE C_D & C_v
RUN 7 DATA POINT 2.2547



6036
H266

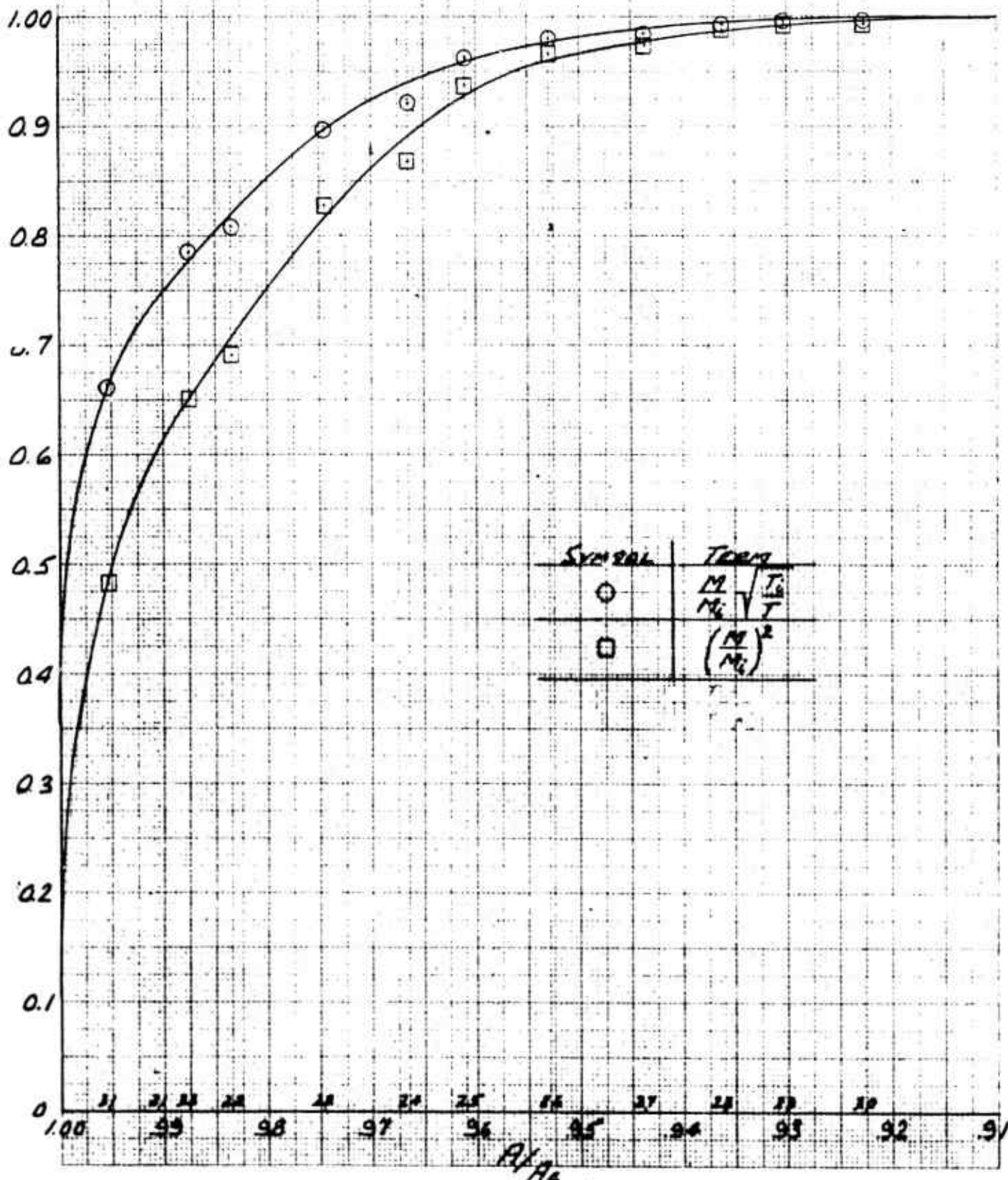
INTEGRATION CURVES
TO DETERMINE CO F CV

RUN 8 DATA POINT 2.2762



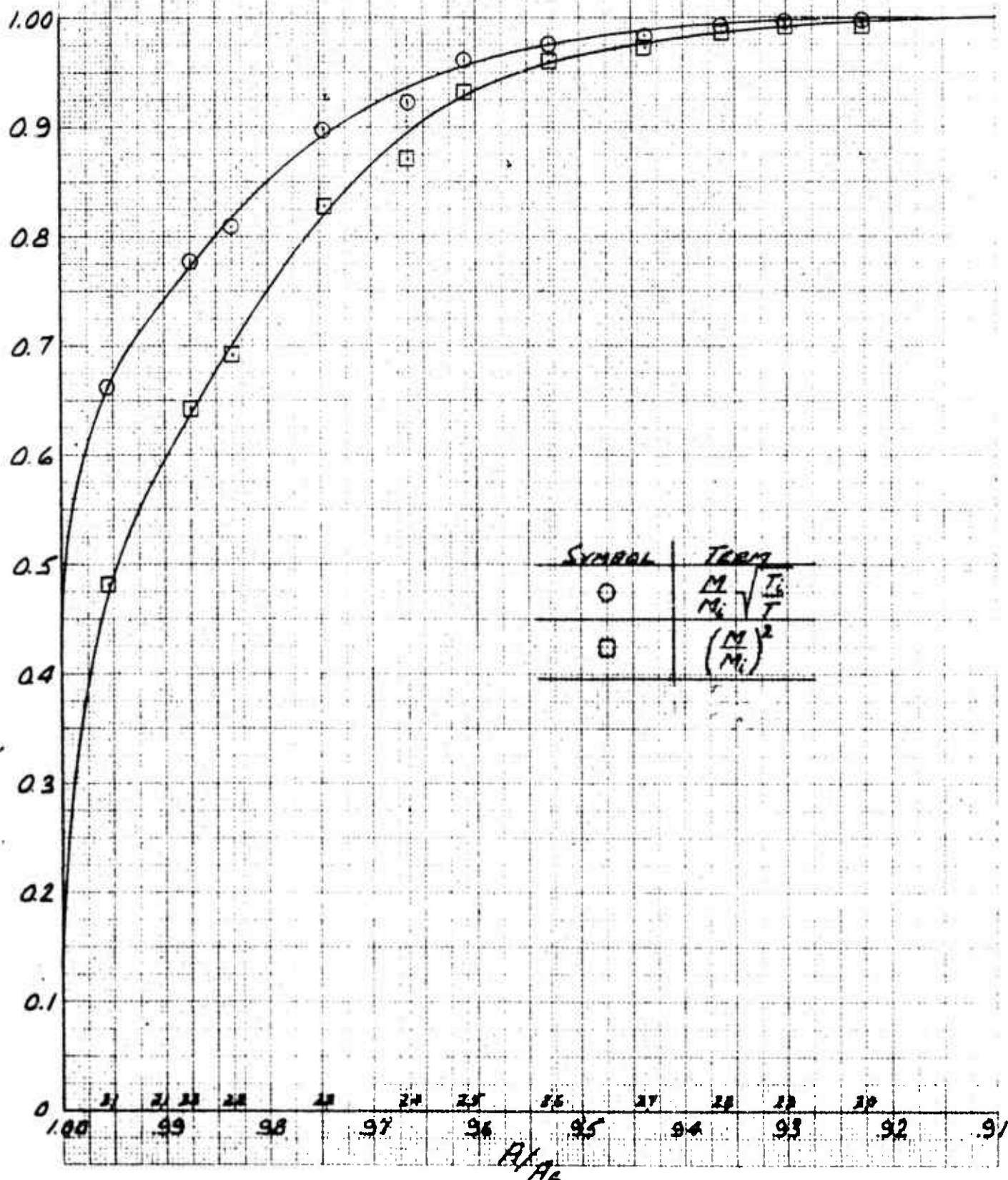
c886
j266

INTEGRATION CURVES
TO DETERMINE C_D & C_V
RUN 9 DATA POINT 2.4867



INTEGRATION CURVES
TO DETERMINE C_D & C_V

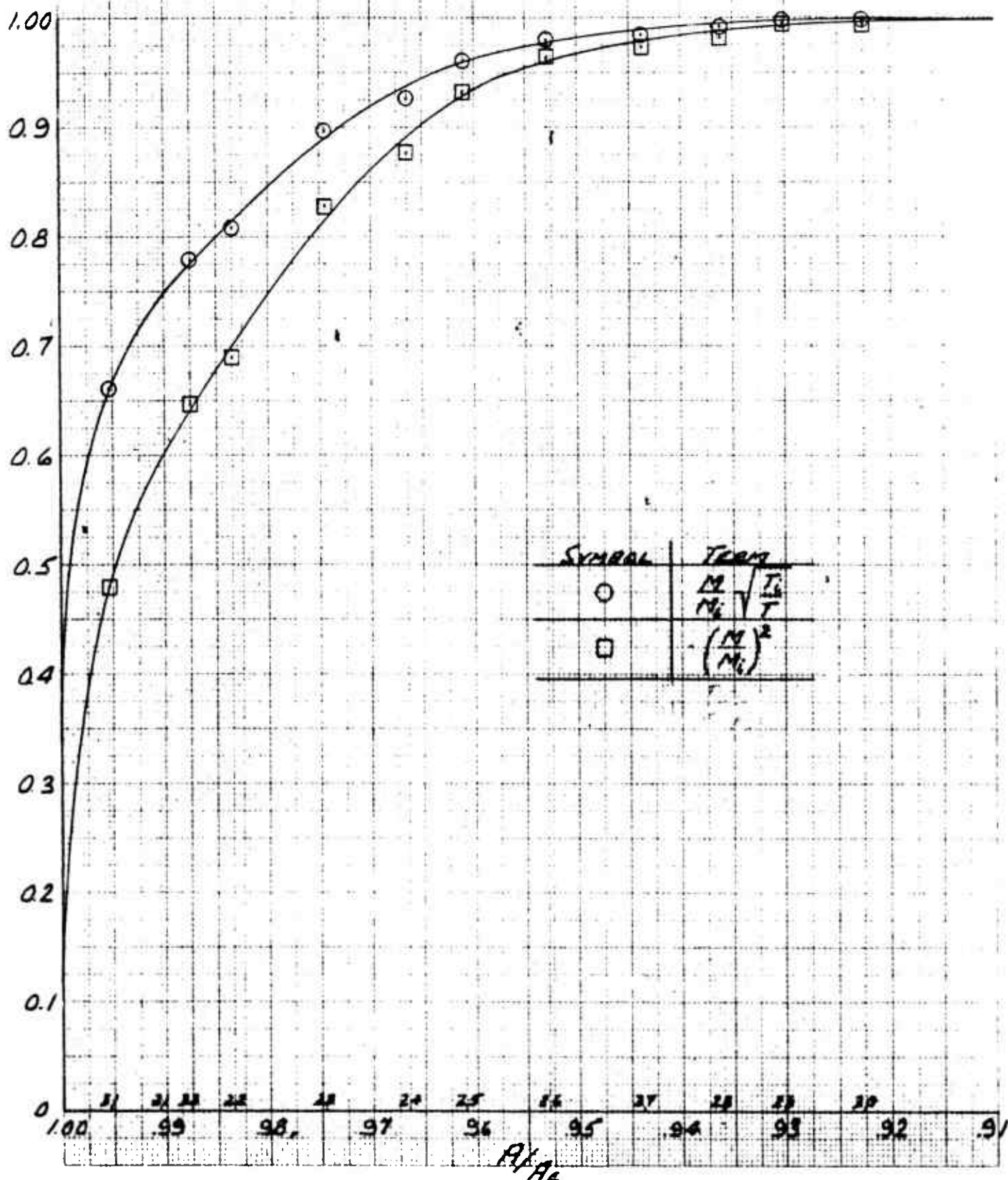
RUN 10 DATA POINT 2.7096



8686
8686

INTEGRATION CURVES
TO DETERMINE C_D & C_V

RUN 11 DATA POINT 2.9037

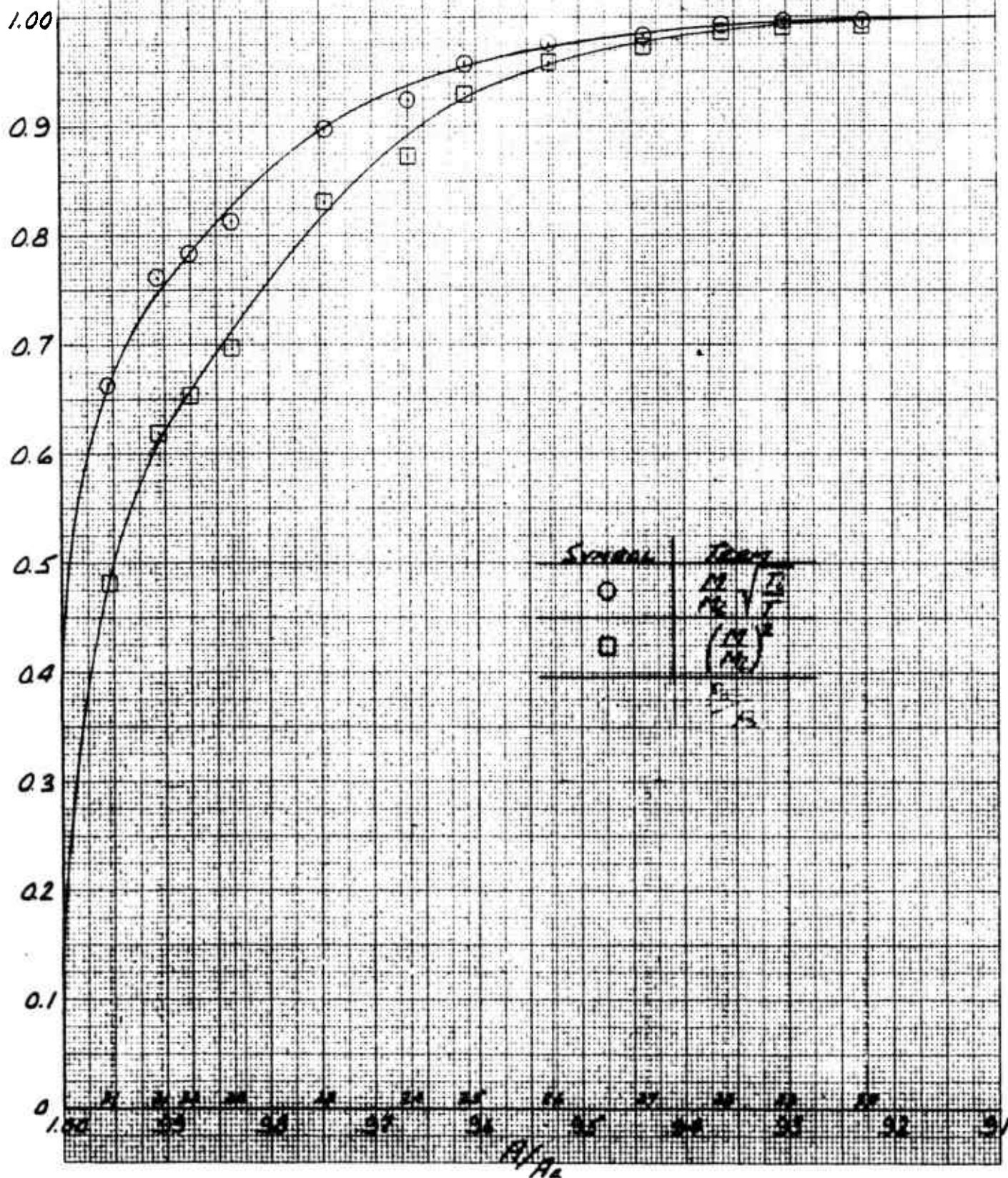


0386
9766

INTEGRATION CURVES

TO DETERMINE C_D & C_V

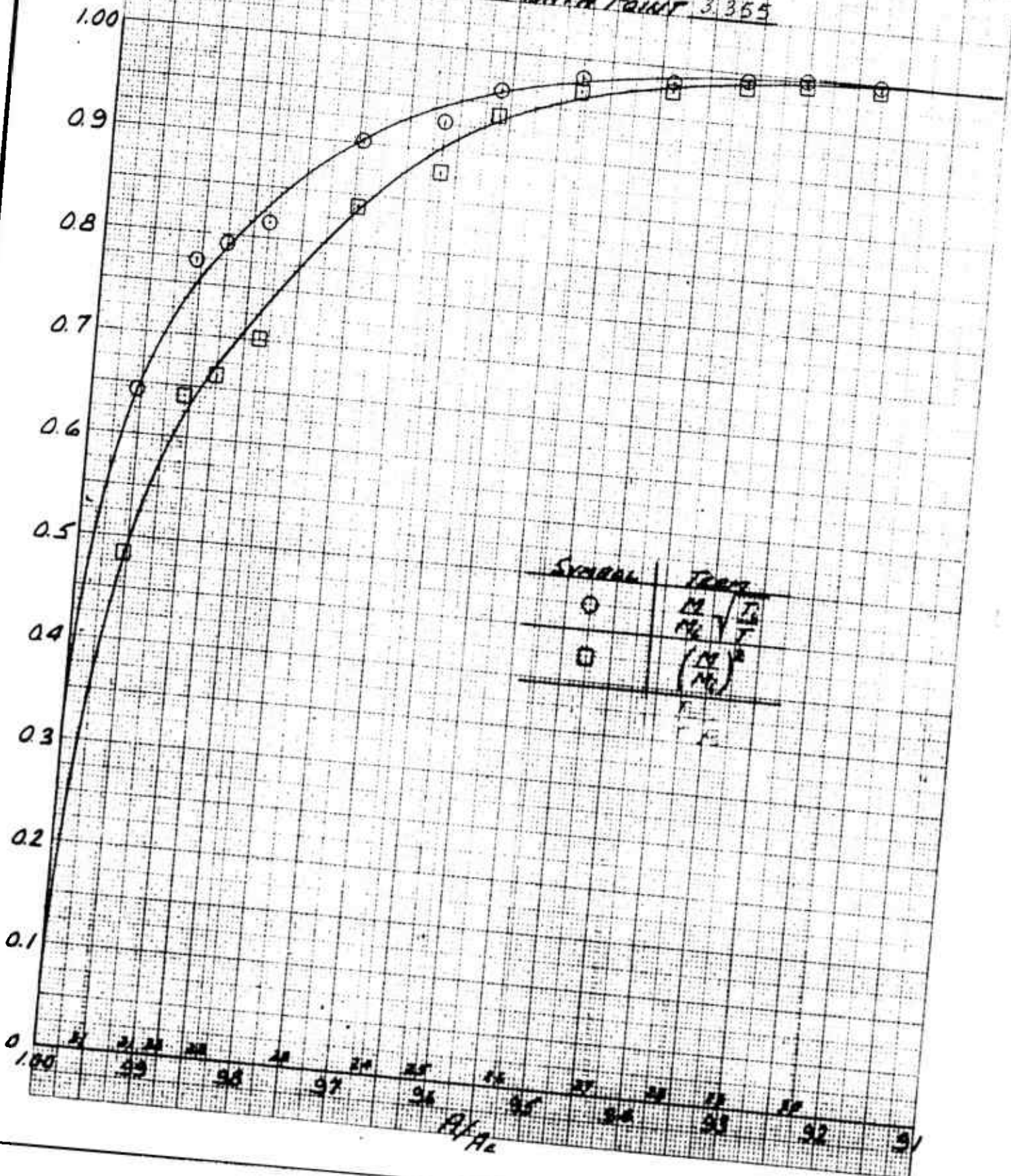
RUN 12 DATA POINT 3.120



8385
5266

FLUIDYNE ENGINEERING CORPORATION

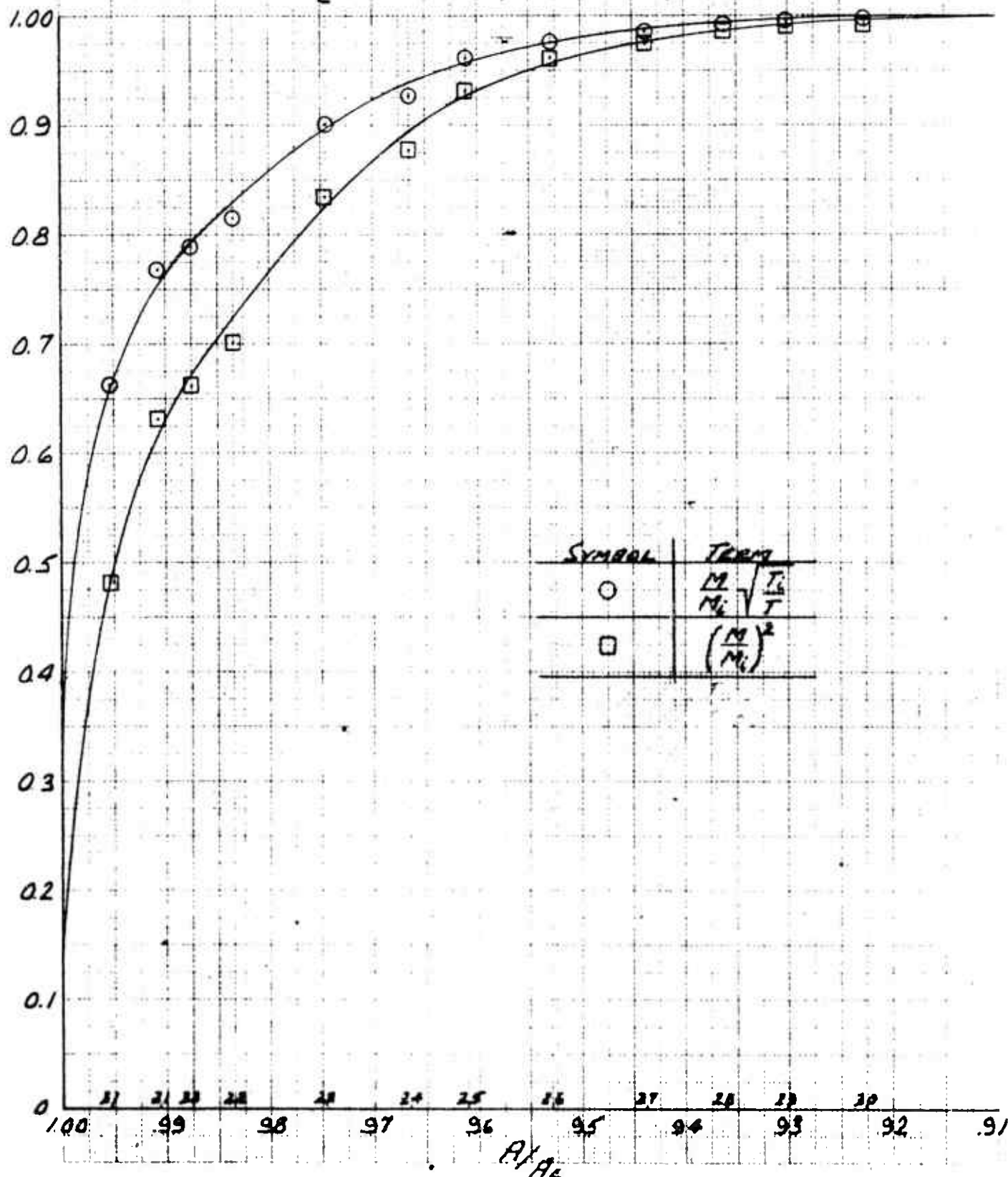
INTEGRATION CURVES
TO DETERMINE C_D & C_V
 RUN 13 DATA POINT 3.355



0536
H666

INTEGRATION CURVES
TO DETERMINE C_D & C_V

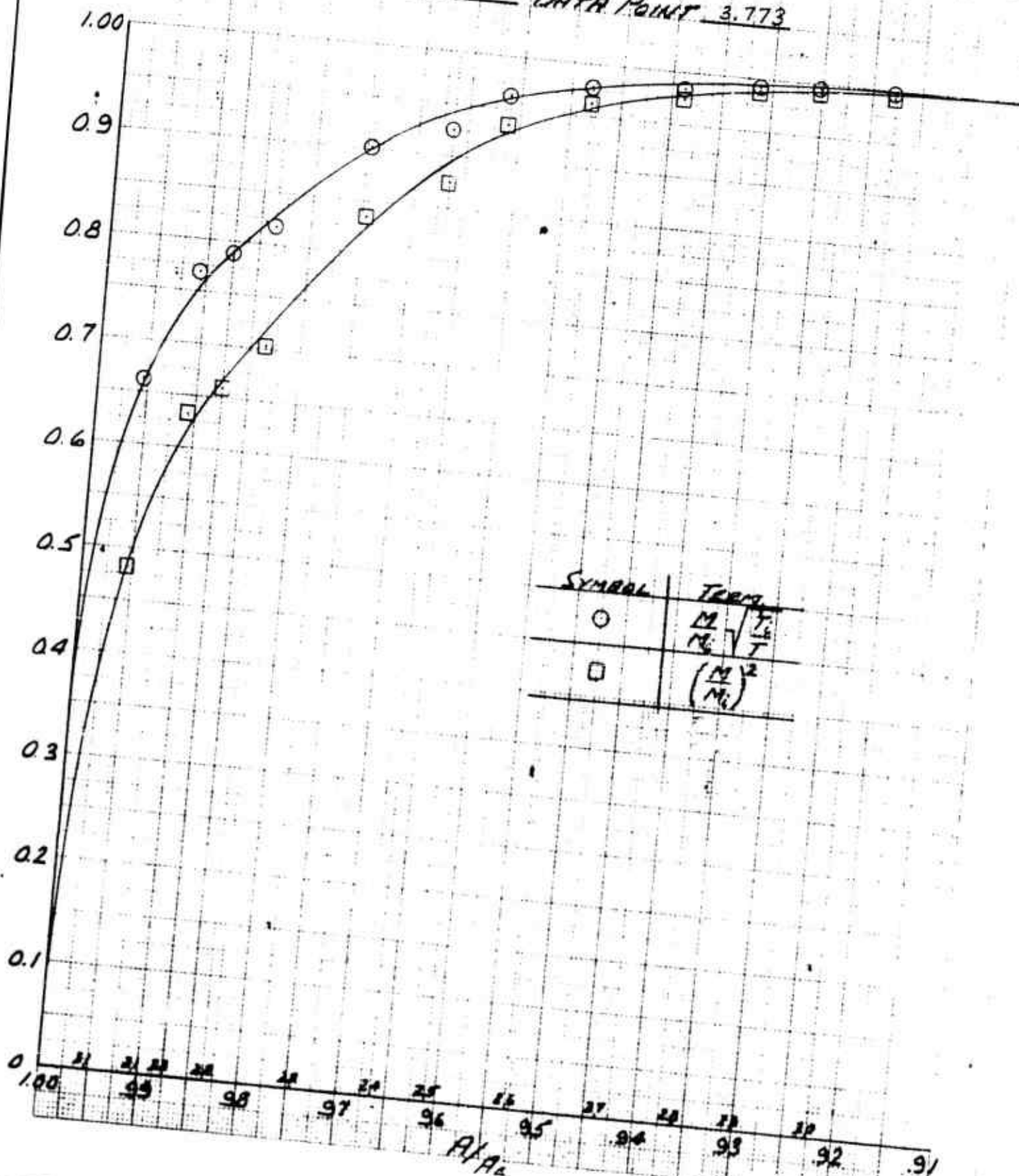
RUN 14 DATA POINT 3.568



0336
9266

FLUIDYNE ENGINEERING CORPORATION

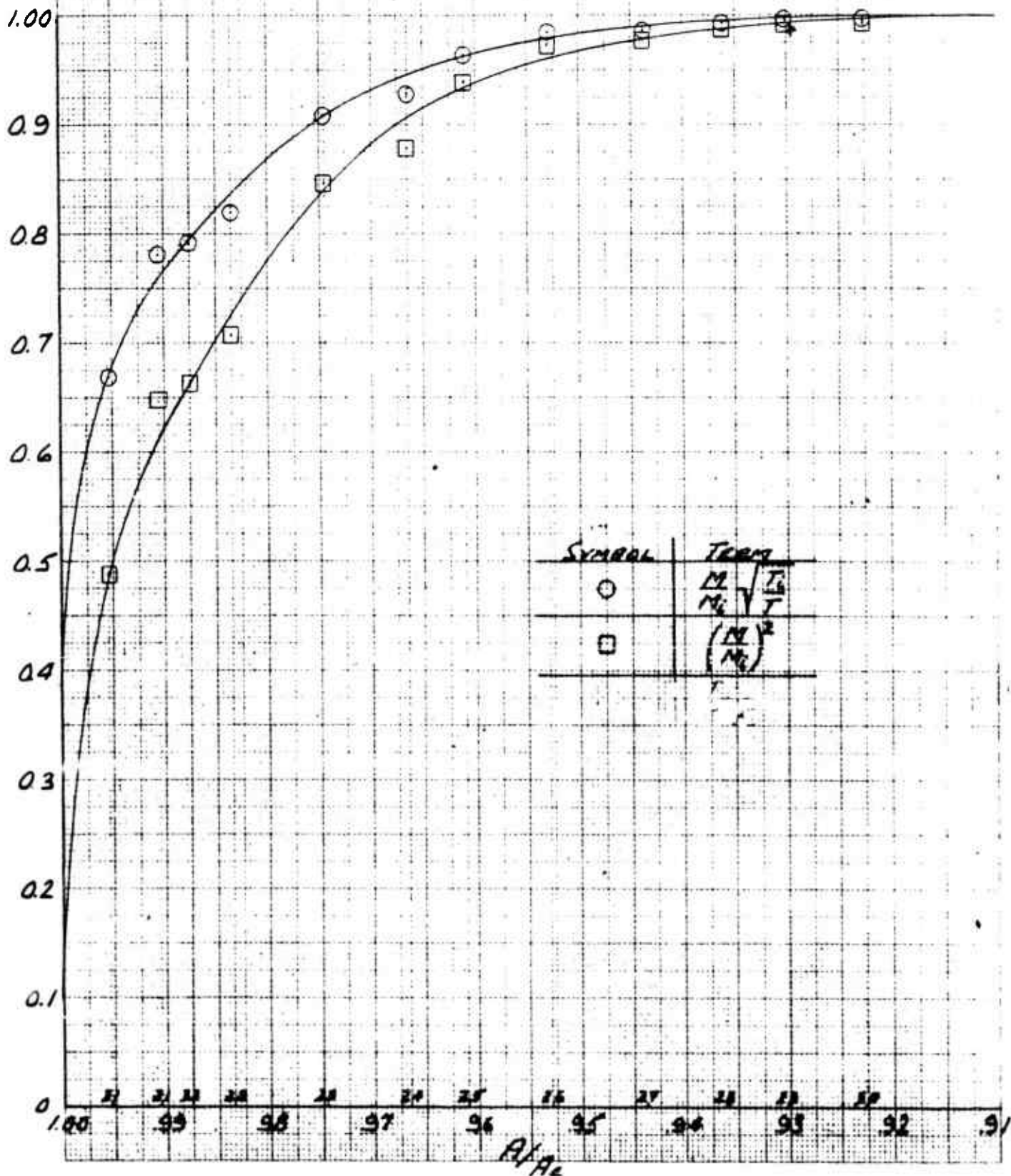
INTEGRATION CURVES
TO DETERMINE C_d & C_v
 RUN 15 DATA POINT 3.773



5236
0866

INTEGRATION CURVES
TO DETERMINE C_D & C_v

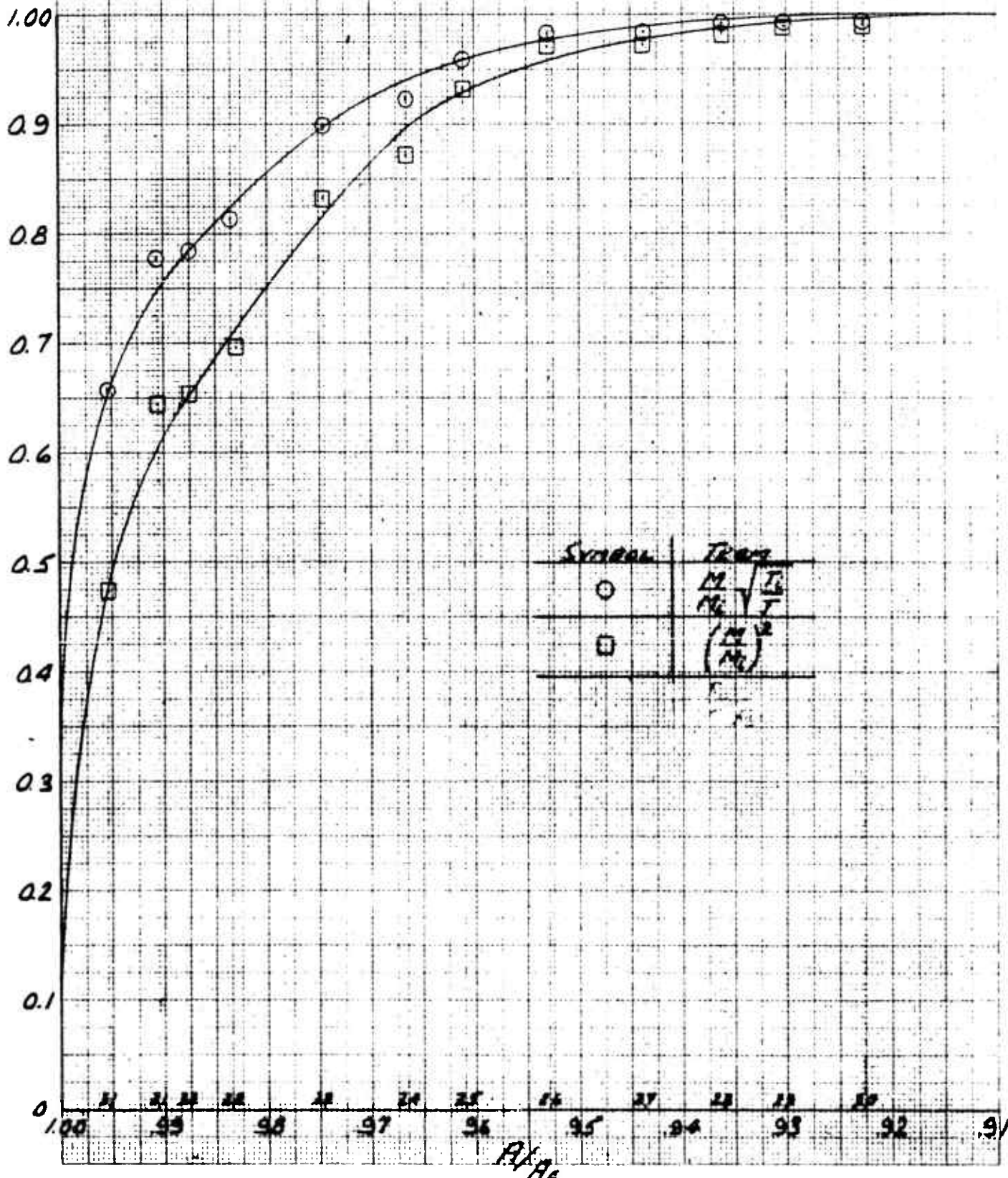
RUN 16 a DATA POINT 3.985



8686
7266

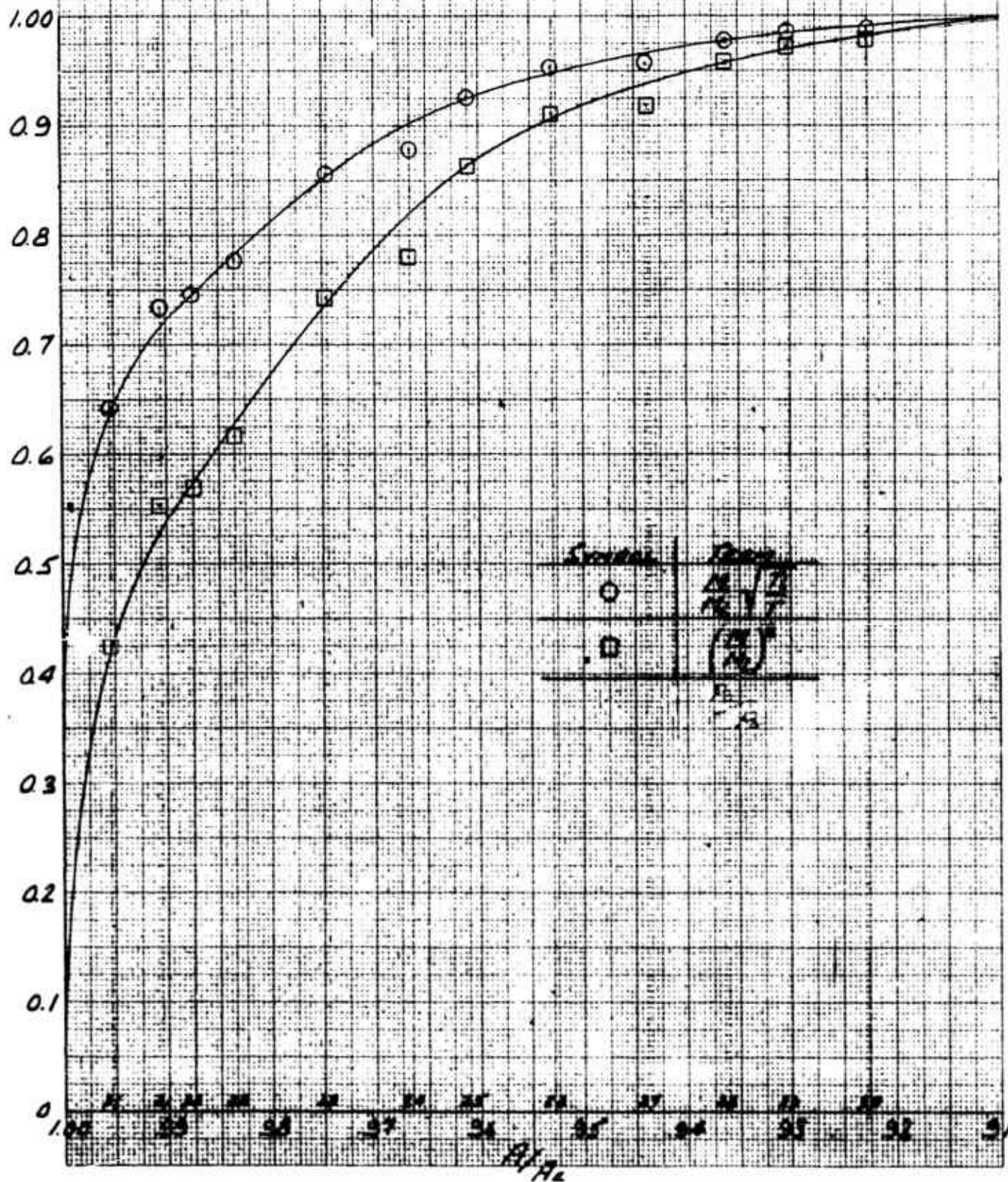
INTEGRATION CURVES
TO DETERMINE C_D & C_L

RUN 166 DATA POINT 3.929



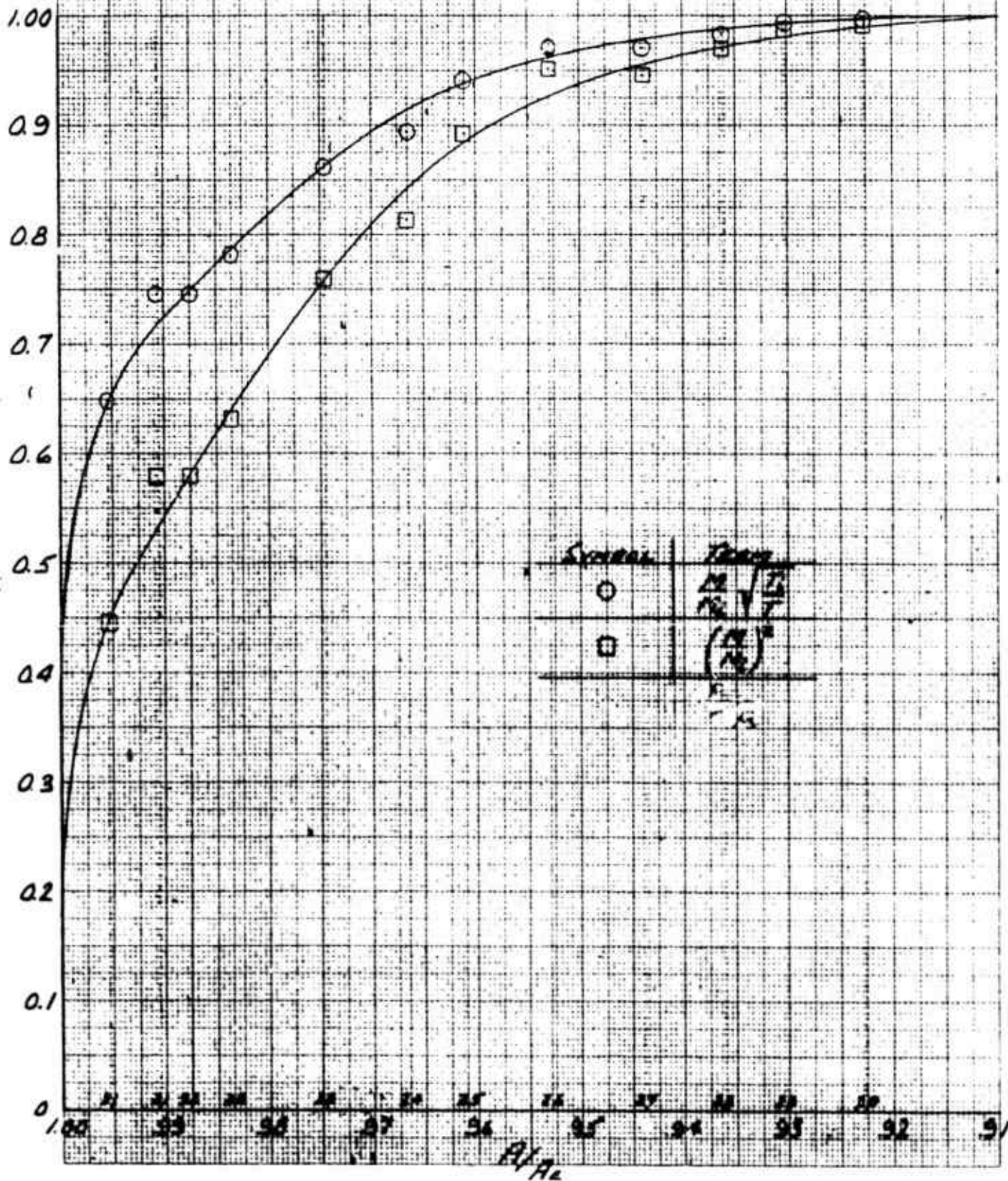
INTEGRATION CURVES
TO DETERMINE C_D & C_L

RUN 17 DATA POINT 1.2192



8576
1166

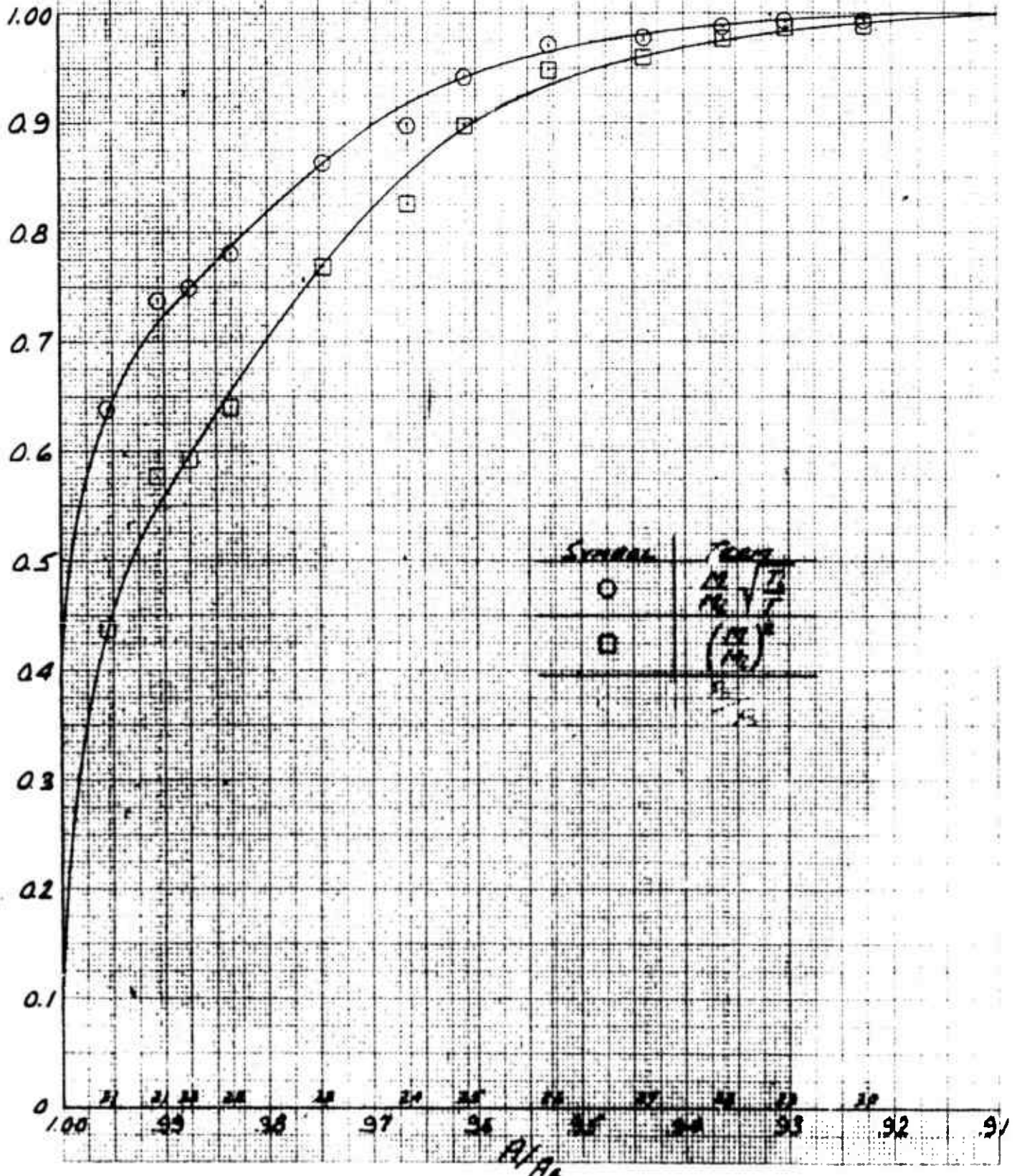
INTEGRATION CURVES
TO DETERMINE C_D & C_L
RUN 18 DATA POINT 1.4308



5536
1166

INTEGRATION CURVES
TO DETERMINE C_D & C_v

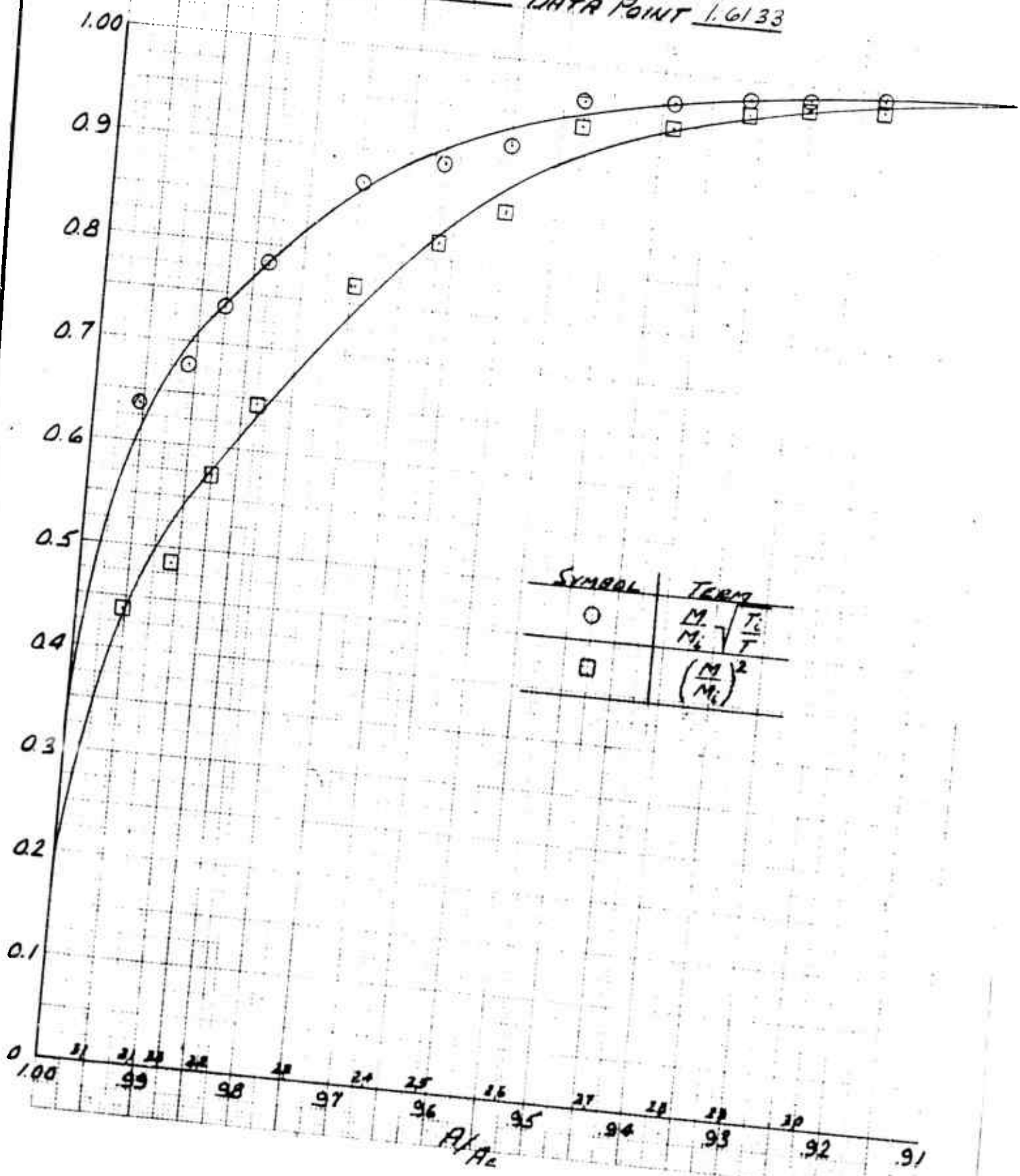
RUN 19 DATA POINT 16472



0786
6066

FLUIDYNE ENGINEERING CORPORATION

INTEGRATION CURVES
TO DETERMINE C_D & C_v
 RUN 20 DATA POINT 1.6133



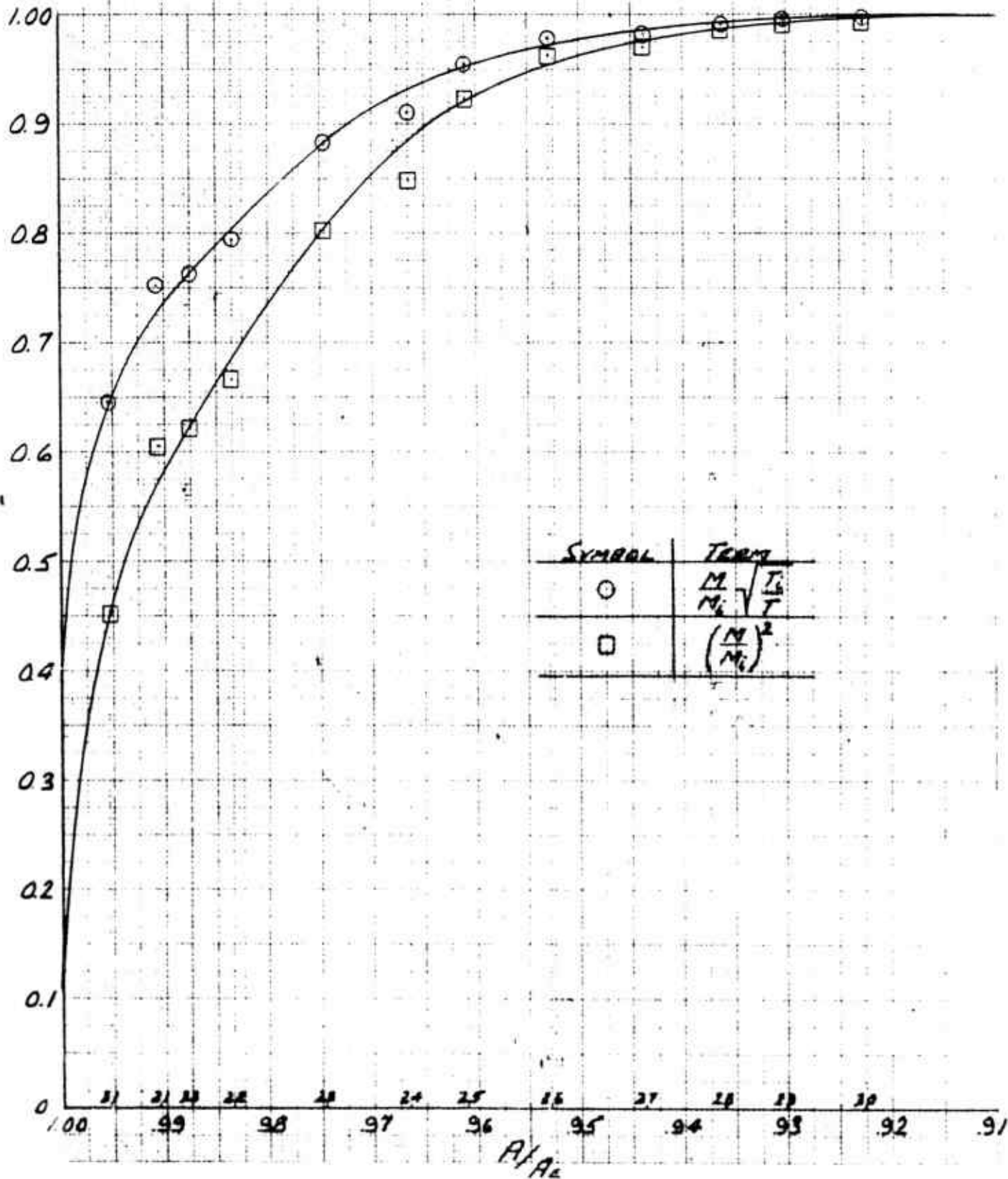
SYMBOL	TERM
○	$\frac{M}{M_i} \sqrt{\frac{T_i}{T}}$
□	$(\frac{M}{M_i})^2$

01.86
1.166

FLUIDDYNE ENGINEERING CORPORATION

INTEGRATION CURVES TO DETERMINE C_D & C_v

RUN 21 DATA POINT 1.8586

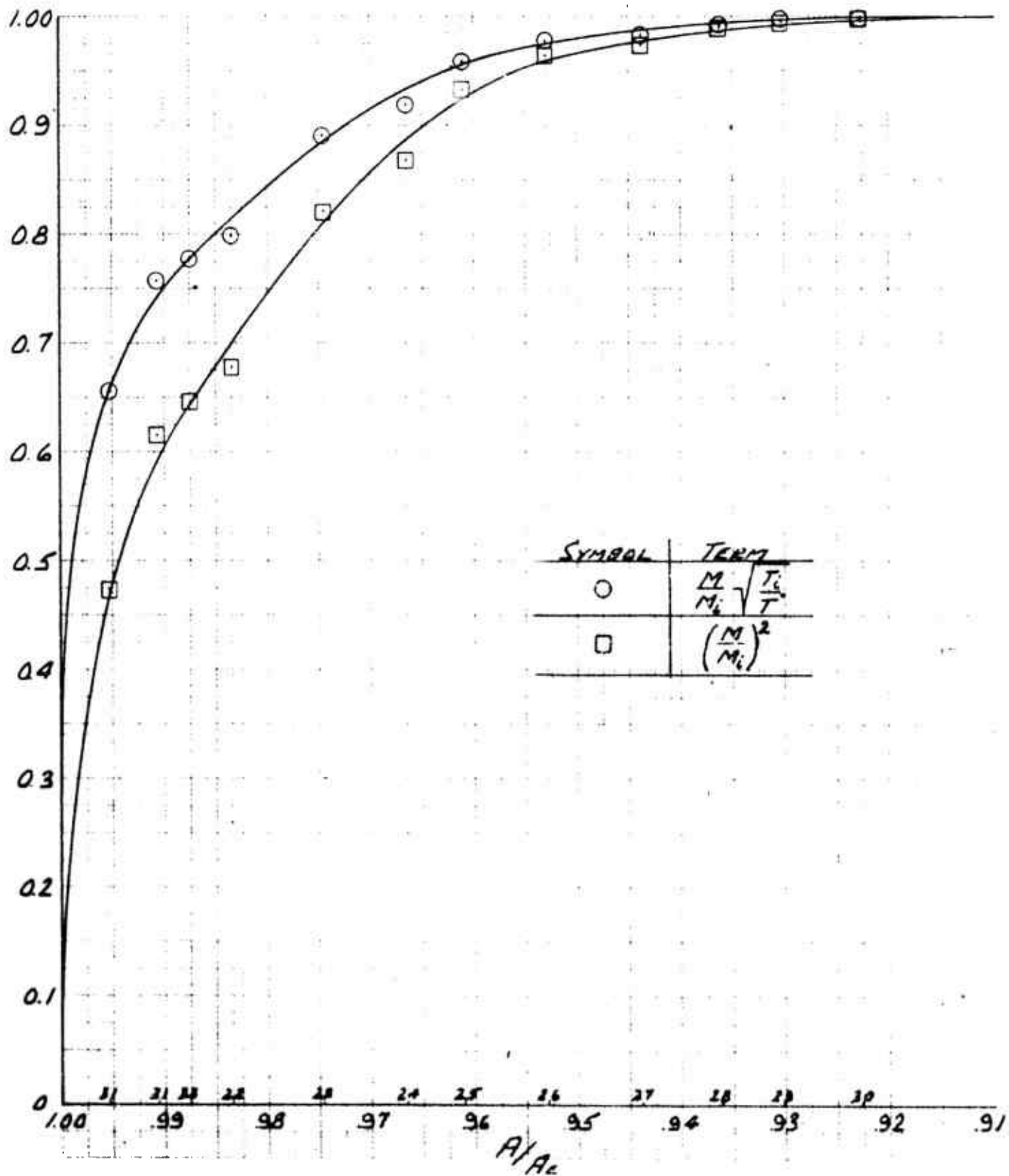


9636
2266

FLUIDYNE ENGINEERING CORPORATION

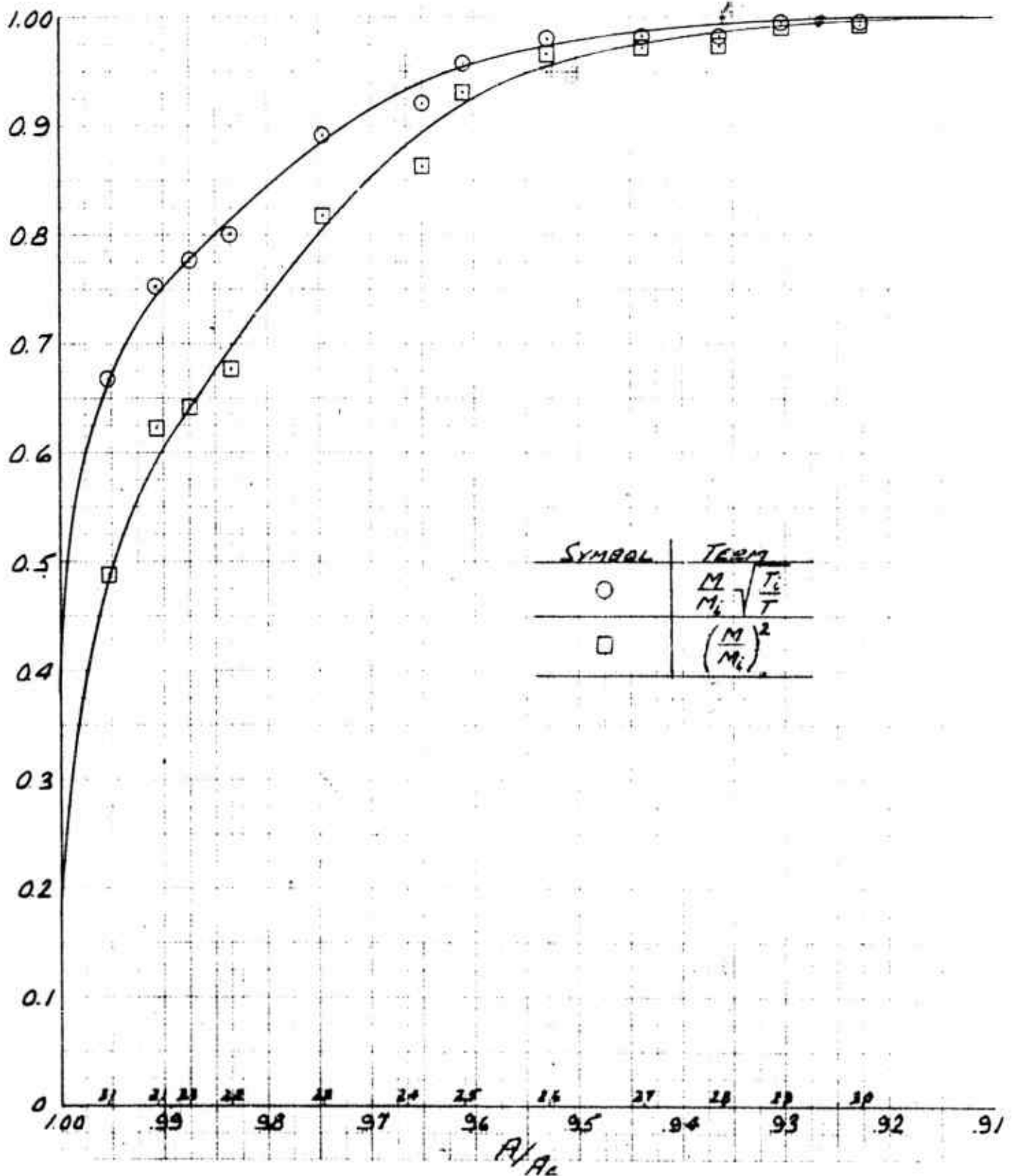
INTEGRATION CURVES TO DETERMINE CO F CV

RUN 22 DATA POINT 2.066



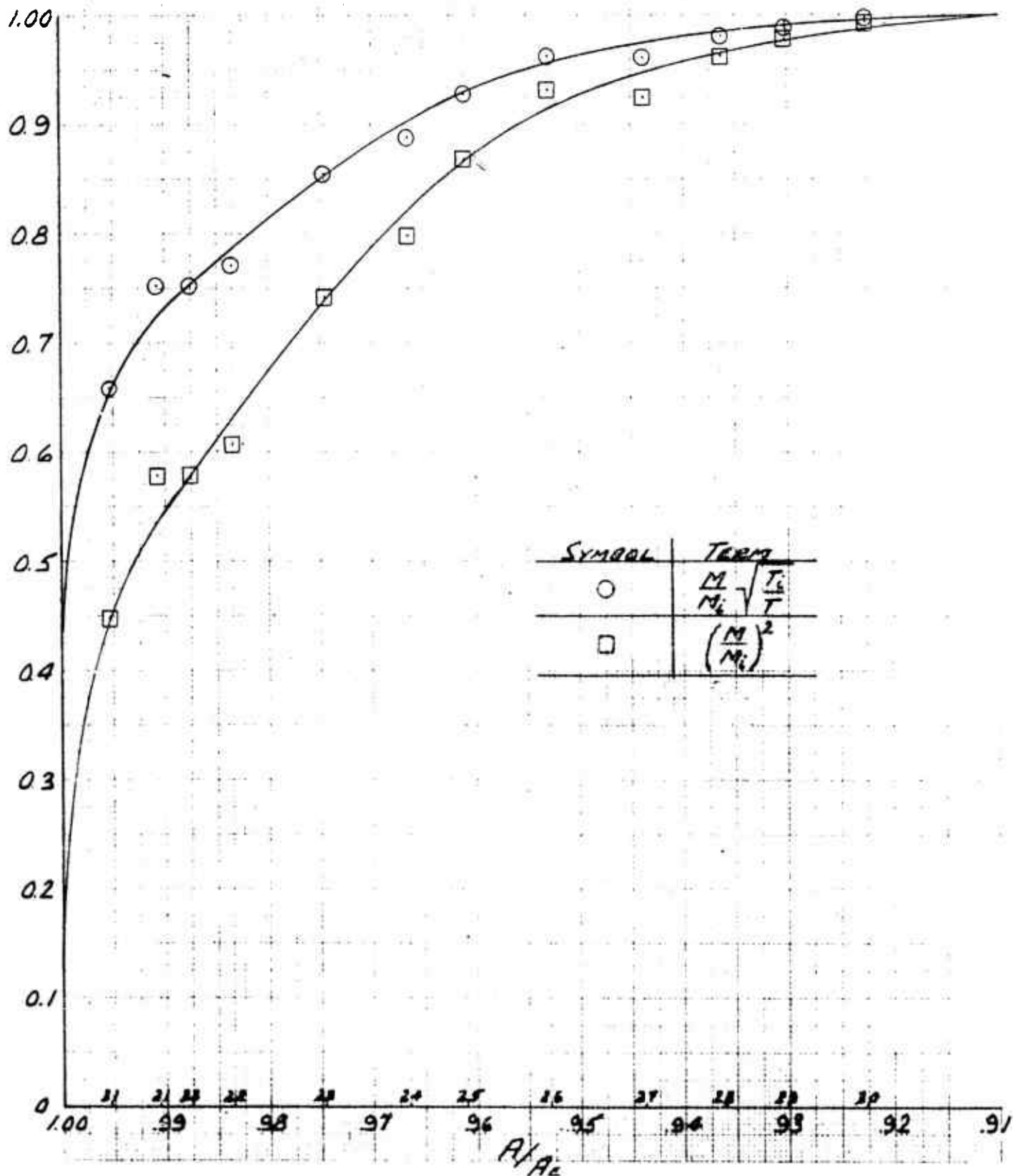
9686
8166

INTEGRATION CURVES
TO DETERMINE C_D & C_v
RUN 23 DATA POINT 2.0734



406
8066

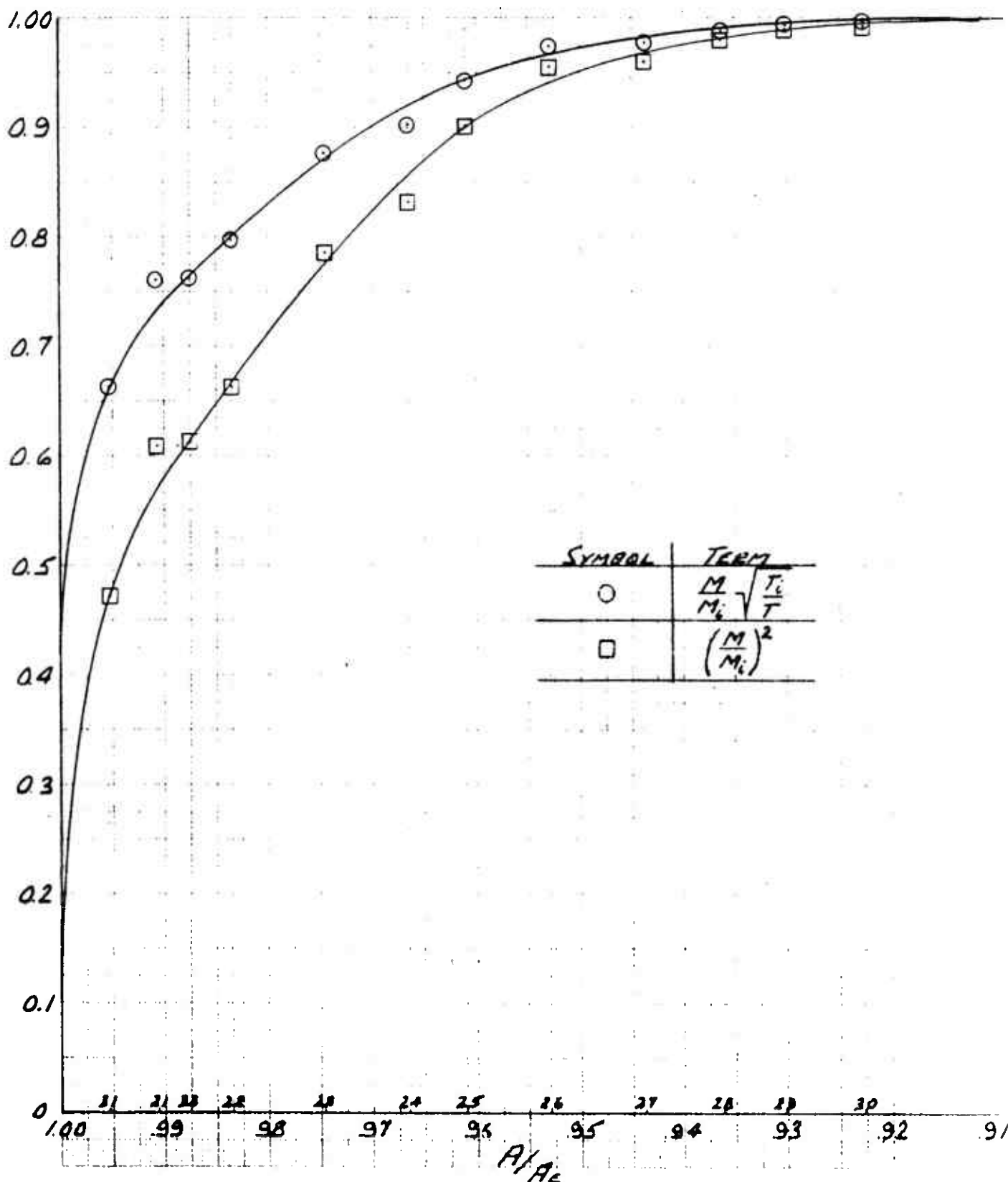
INTEGRATION CURVES
TO DETERMINE C_D & C_v
 RUN 24 DATA POINT 1.2133



8166
8166

INTEGRATION CURVES
TO DETERMINE C_D & C_V

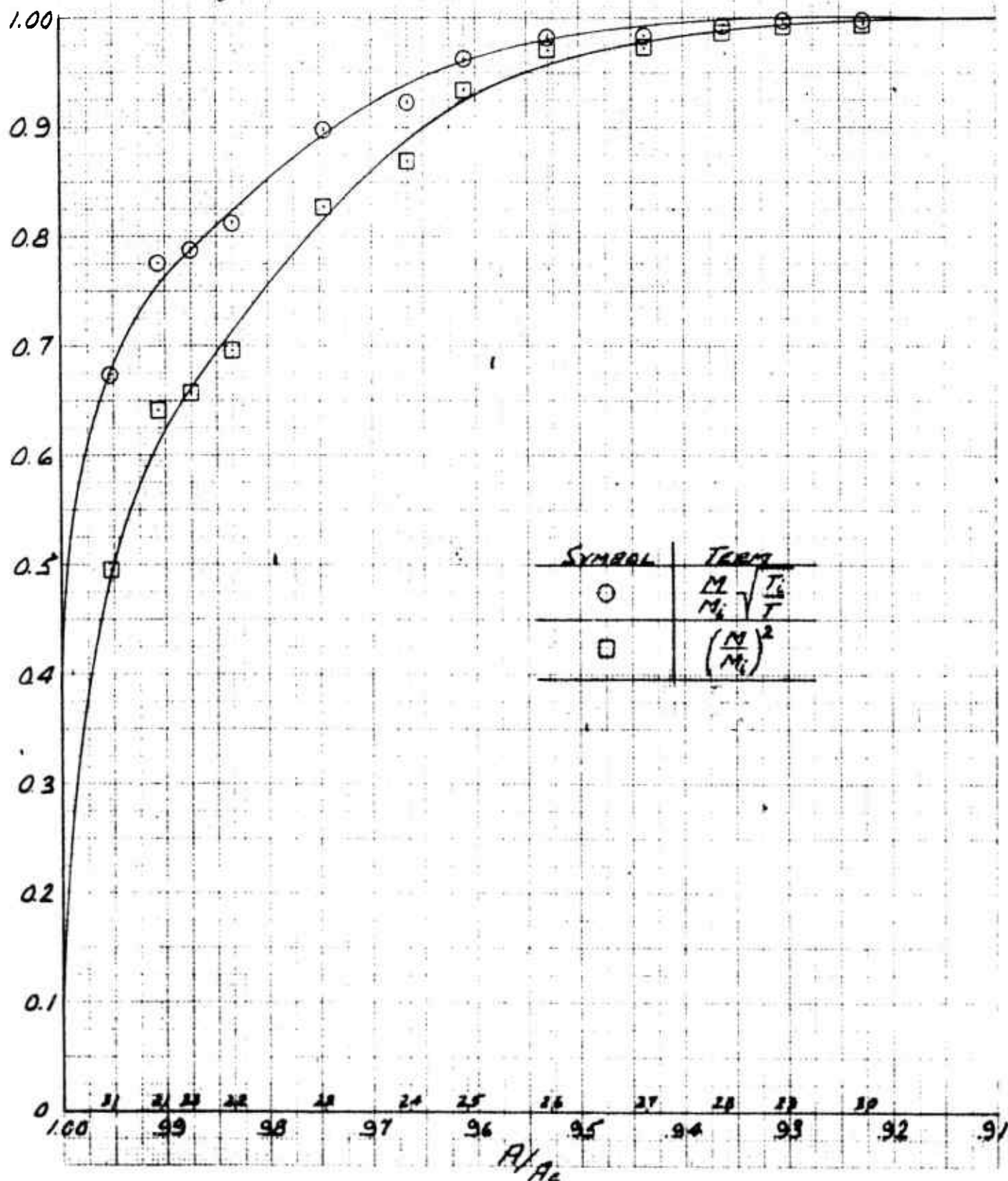
RUN 25 DATA POINT 1,6471



6L86
8766

INTEGRATION CURVES
TO DETERMINE C_p & C_v

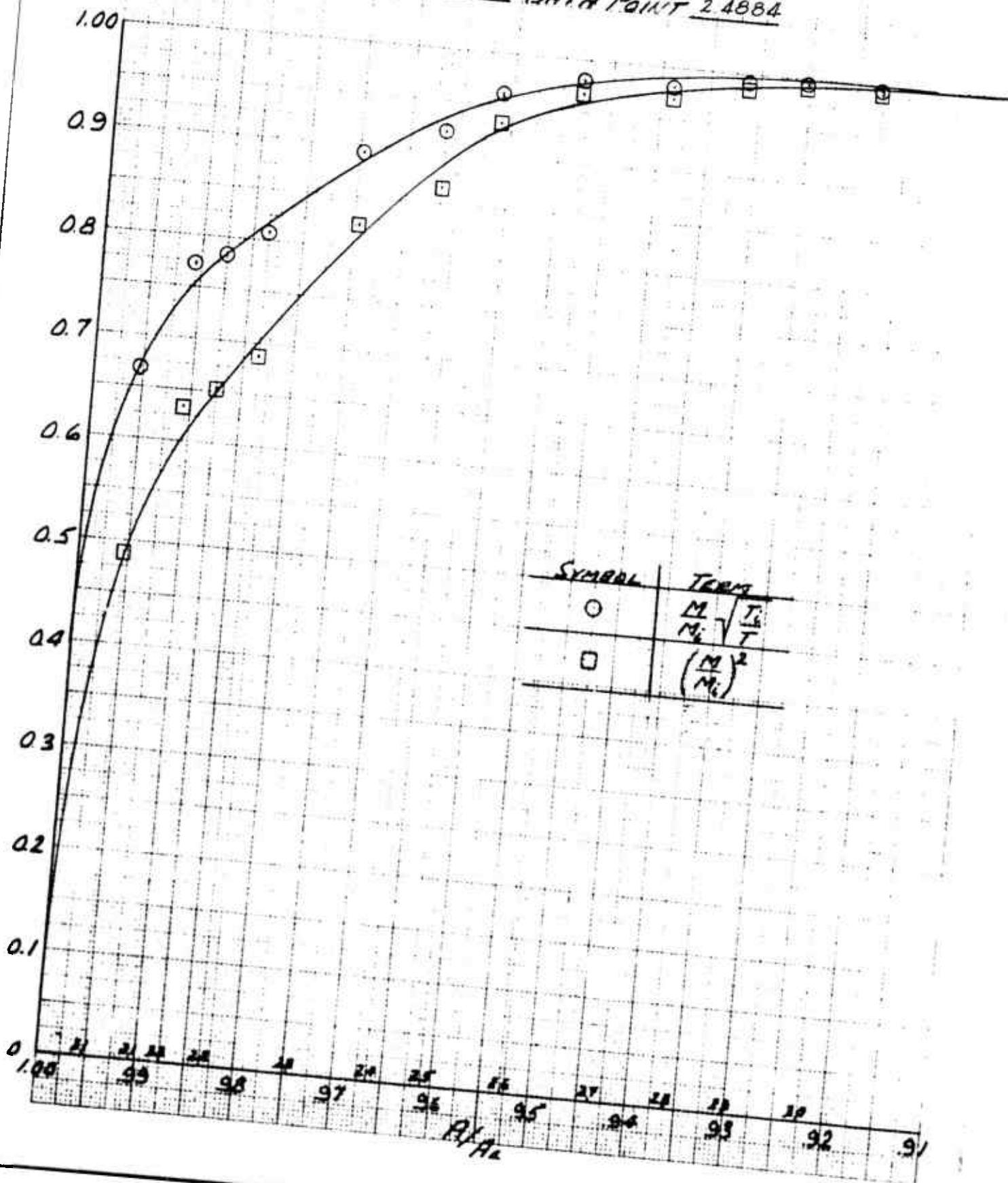
RUN 26 DATA POINT 2.4977



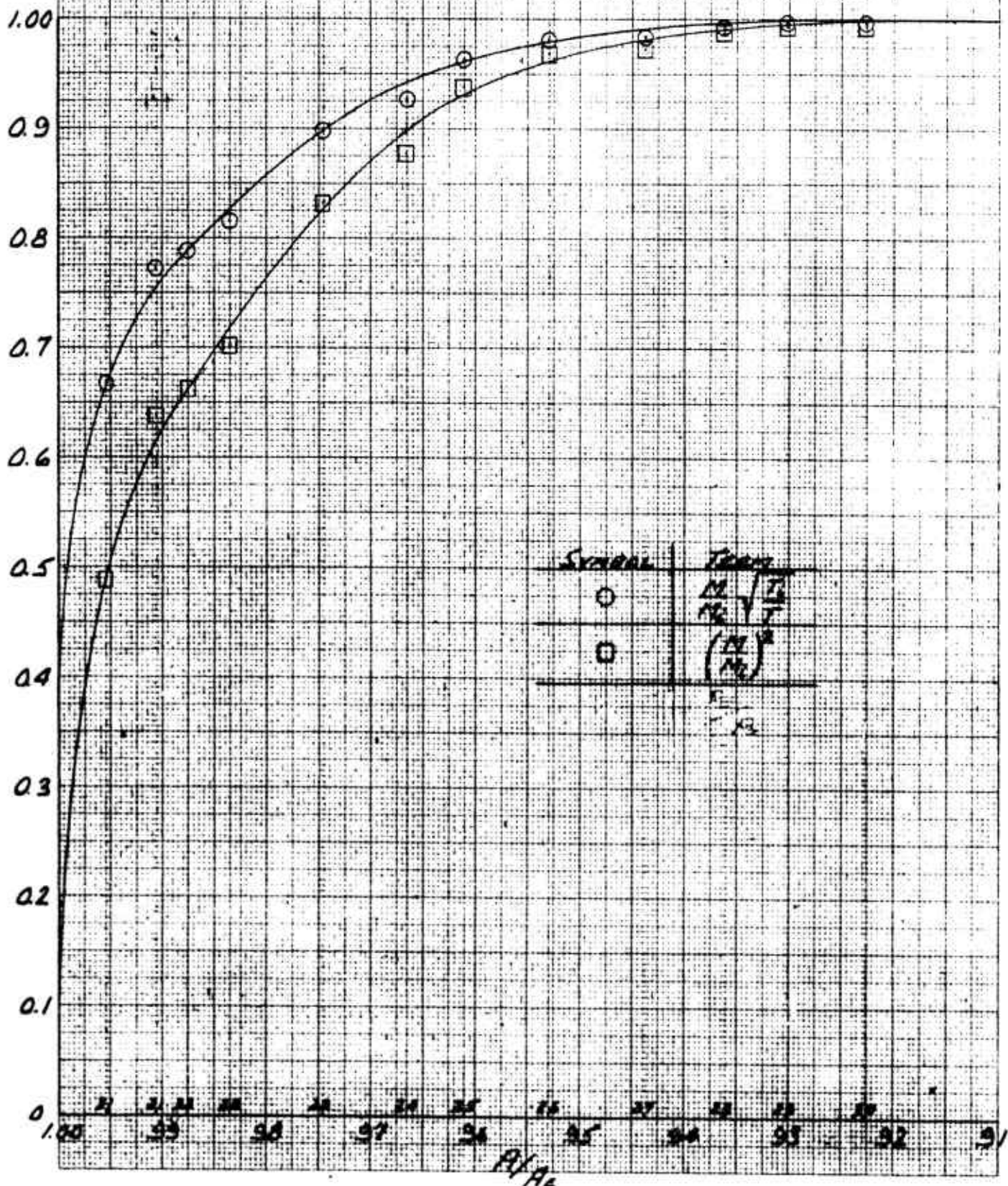
8L86
5166

FLUIDYNE ENGINEERING CORPORATION

INTEGRATION CURVES
TO DETERMINE C_D & C_V
 RUN 27 DATA POINT 24884

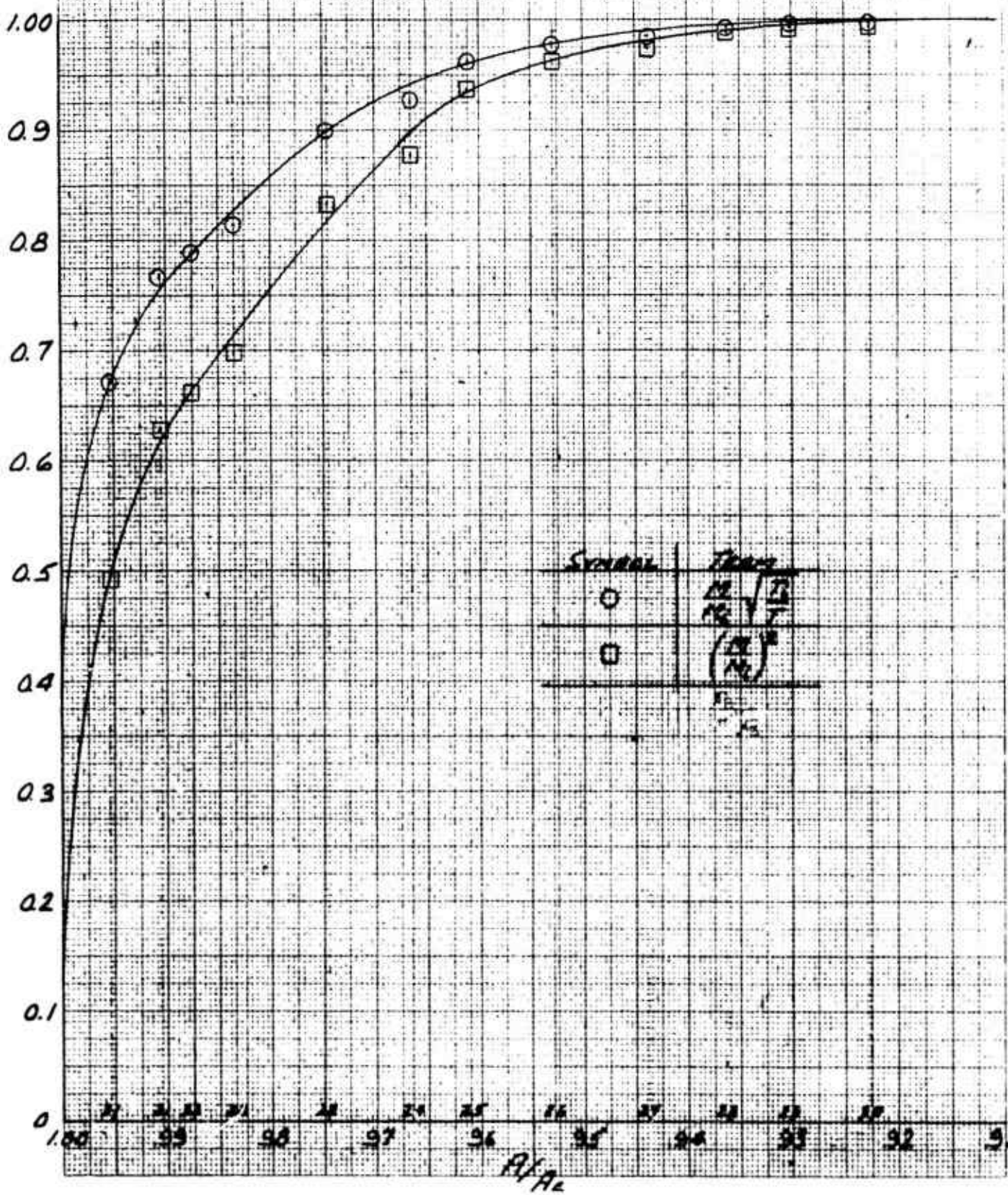


INTEGRATION CURVES
TO DETERMINE C_D & C_v
RUN 28 DATA POINT 31284



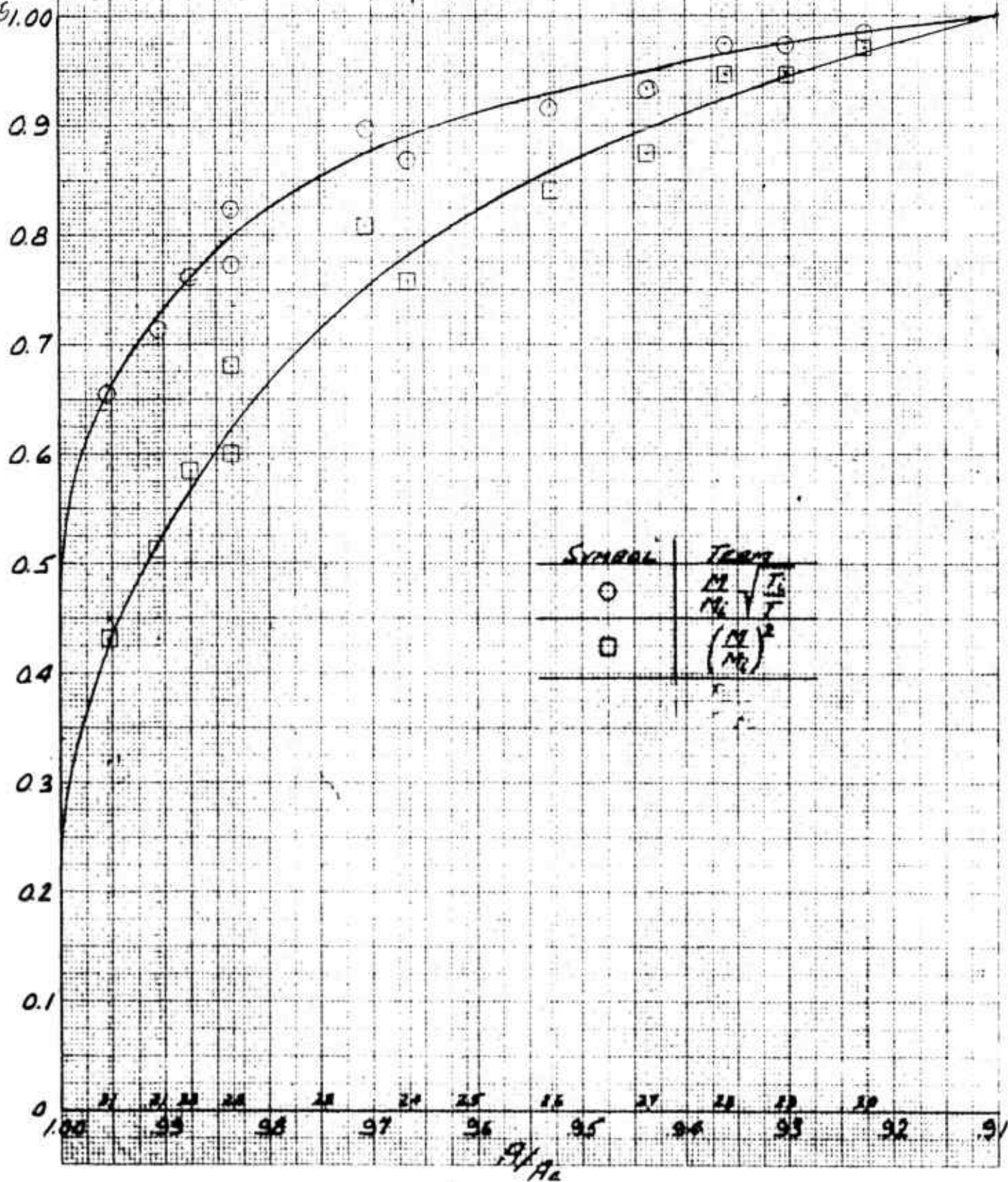
2386
8466

INTEGRATION CURVES
TO DETERMINE C_D & C_L
 RUN 29 DATA POINT 3.1357



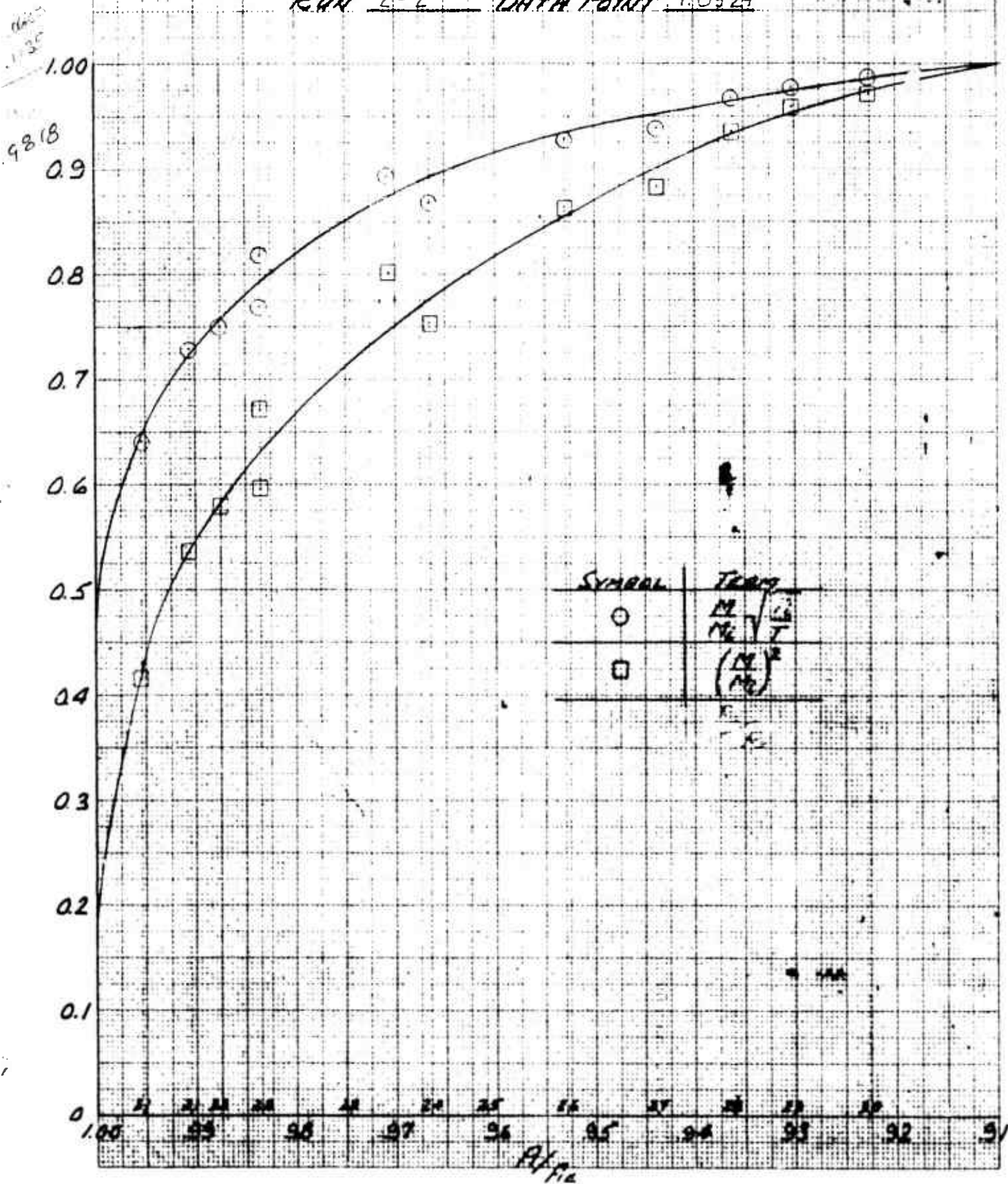
INTEGRATION CURVES
TO DETERMINE C_D & C_V

RUN 2-1 DATA POINT 1.0322



INTEGRATION CURVES
TO DETERMINE C_D & C_V

RUN 2-2 DATA POINT 1.0529

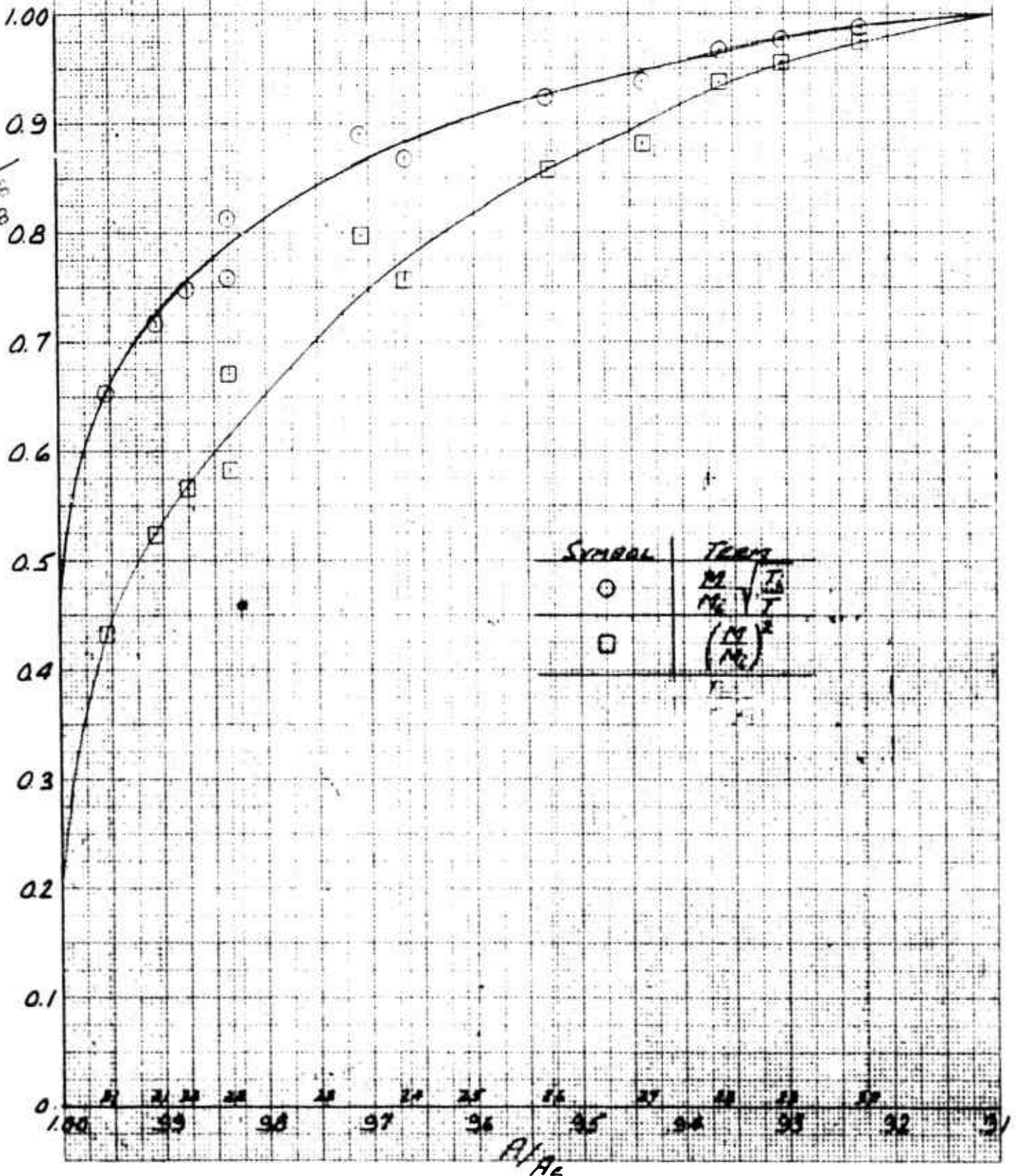


FLUIDDYNE ENGINEERING CORPORATION

INTEGRATION CURVES TO DETERMINE CO F CV

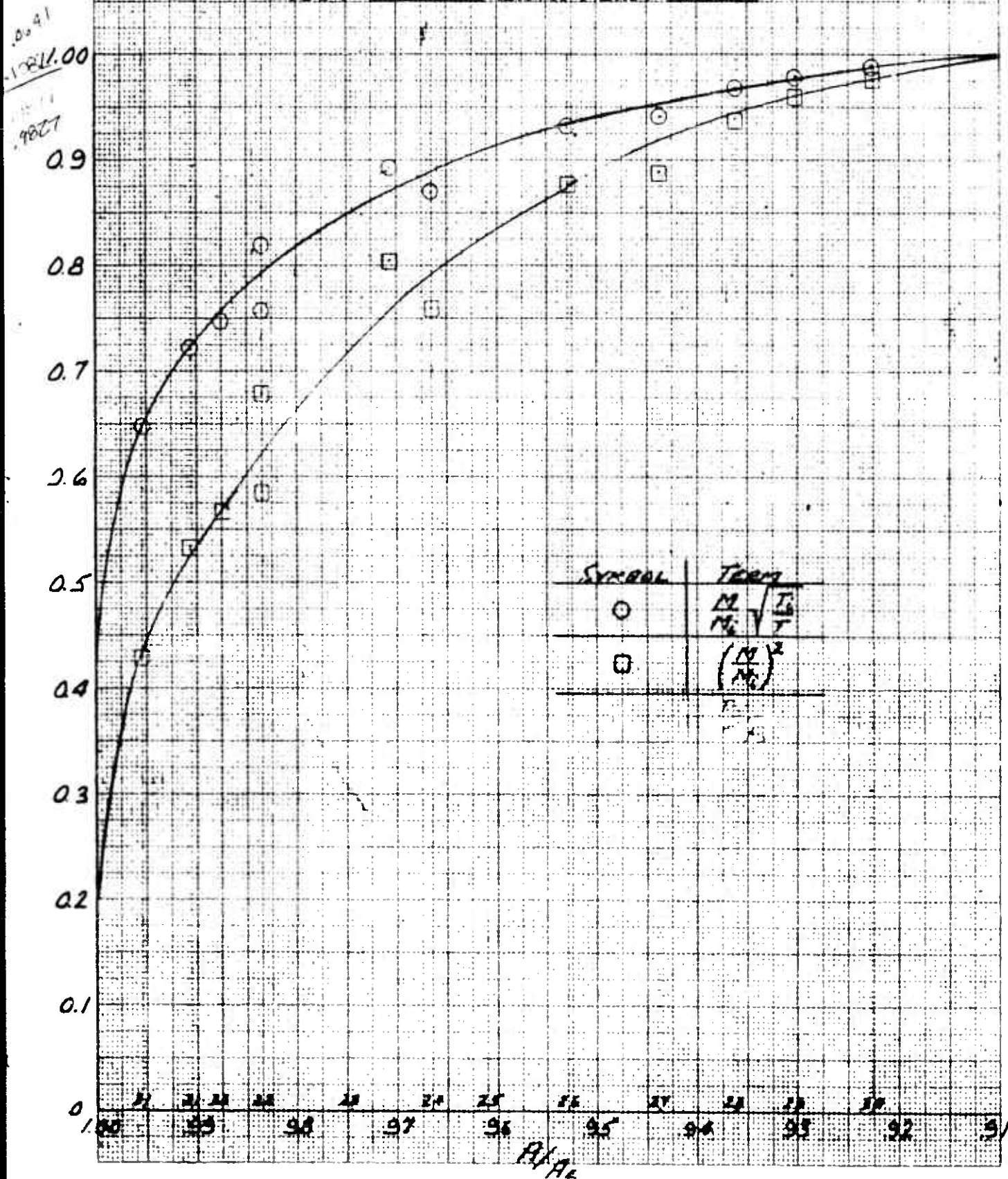
RUN 2-3 DATA POINT 1.1062

0.0643
-1135
2215
-9818



INTEGRATION CURVES
TO DETERMINE C_D & C_V

RUN 2-4 DATA POINT 1.1525



INTEGRATION CURVES
TO DETERMINE C_D & C_V

RUN 2-5 DATA POINT 12018

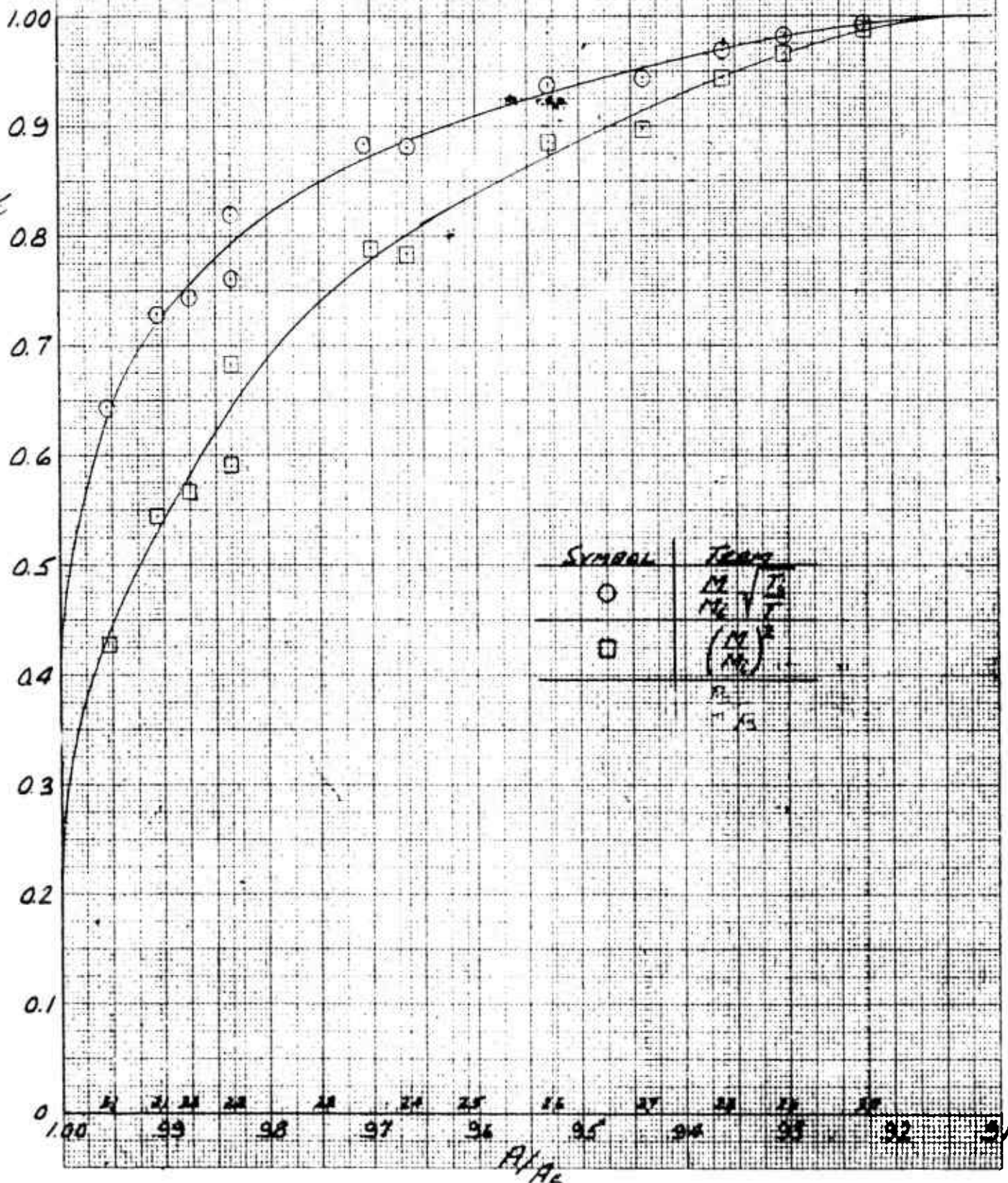


TABLE 1 TABULATED TEST RESULTS

Data Point	Press. Ratio	Po (psia)	Ps (psia)	Pa (psia)	Ps/Pa	$\sqrt{\frac{M}{M_1}} \sqrt{\frac{T_1}{T}}$	$\frac{dA}{AE}$	$\int \left(\frac{M}{M_1}\right)$
1	1.209	17.23	14.29	14.25	1.0031	.9902		.
2	2.408	35.20	18.21	14.25	1.2779	.9923		.
3	1.418	20.14	14.28	14.21	1.0052	.9905		.
4	1.643	23.34	14.32	14.21	1.0079	.9905		.
5	1.857	26.37	14.45	14.21	1.0176	.9915		.
6	2.059	29.25	15.41	14.21	1.0848	.9921		.
8	2.276	32.23	16.79	14.42	1.1860	.9924		.
9	2.487	35.21	18.35	14.42	1.2959	.9925		.
10	2.710	38.37	20.02	14.42	1.4141	.9925		.
11	2.904	41.05	21.27	14.14	1.5052	.9923		.
12	3.120	44.09	22.83	14.13	1.6193	.9925		.
13	3.355	47.20	24.57	14.05	1.7491	.9925		.
14	3.568	50.10	26.11	14.04	1.8602	.9924		.
15	3.773	52.96	27.60	14.04	1.9662	.9926		.
16a	3.985	55.93	29.27	14.03	2.0354	.9930		.
16b	3.929	55.13	28.79	14.03	2.0513	.9924		.
17	1.219	17.12	14.07	14.04	1.0021	.9903		.
18	1.431	20.09	14.10	14.04	1.0045	.9911		.
19	1.647	23.13	14.13	14.04	1.0066	.9912		.
20	1.613	23.14	14.13	14.04	1.0063	.9903		.
21	1.859	26.10	14.23	14.04	1.0171	.9917		.
22	2.066	29.00	15.25	14.04	1.0361	.9922		.
23	2.073	29.11	15.27	14.04	1.0375	.9923		.
24	1.213	17.10	14.14	14.09	1.0035	.9908		.
25	1.647	23.21	14.43	14.09	1.0278	.9913		.
26	2.498	35.20	13.85	14.09	1.3373	.9923		.
27	2.488	35.07	13.31	14.09	1.3348	.9925		.
28	3.123	44.13	22.94	14.11	1.6260	.9927		.
29	3.136	44.24	23.02	14.11	1.6319	.9923		.
2-1	1.032	14.855	14.223	14.227	1.00007	.9893		.
2-2	1.053	14.930	14.229	14.227	1.00010	.9900		.
2-3	1.106	15.733	14.229	14.227	1.00012	.9893		.
2-4	1.152	16.397	14.231	14.227	1.00027	.9897		.
2-5	1.202	17.099	14.232	14.227	1.00033	.9900		.

TEST RESULTS

	$\frac{dA}{AE}$	$\int \left(\frac{M}{MI}\right)^2 \frac{dA}{AE}$	C_D	C_V	C_s	Thrt. Re x 10 ⁻⁶
02		.9829	.9902	.9927	1.1541	2.54
23		.9874	.9923	.9952	1.2689	7.47
05		.9840	.9905	.9953	1.2248	3.62
05		.9851	.9905	.9948	1.2592	4.66
15		.9865	.9915	.9952	1.2683	5.60
21		.9869	.9921	.9953	1.2682	6.19
24		.9879	.9924	.9968	1.2704	6.83
25		.9880	.9925	.9953	1.2680	7.47
25		.9876	.9925	.9941	1.2683	8.15
23		.9878	.9923	.9918	1.2683	8.70
25		.9880	.9925	.9888	1.2704	9.44
25		.9883	.9925	.9880	1.2686	10.0
24		.9880	.9924	.9875	1.2678	10.6
26		.9880	.9926	.9838	1.2681	11.2
30		.9885	.9930	.9819	1.2683	12.0
24		.9873	.9924	.9829	1.2683	11.9
03		.9836	.9903	.9929	1.1593	2.52
11		.9853	.9911	.9938	1.2283	3.62
12		.9855	.9912	.9939	1.2592	4.60
03		.9840	.9903	.9936	1.2587	4.60
17		.9870	.9917	.9954	1.2684	5.54
22		.9376	.9922	.9937	1.2683	6.15
23		.9876	.9923	.9957	1.2711	6.17
08		.9843	.9903	.9939	1.1554	2.53
13		.9354	.9913	.9950	1.2557	4.62
28		.9879	.9928	.9953	1.2681	7.49
25		.9373	.9925	.9953	1.2684	7.43
27		.9882	.9927	.9895	1.2631	4.51
23		.9332	.9925	.9903	1.2679	9.72
93		.9815	.9393	.9921	1.0402	0.94
00		.9818	.9900	.9917	1.0571	1.25
93		.9813	.9393	.9919	1.0968	1.73
97		.9327	.9397	.9929	1.1261	2.11
00		.9835	.9900	.9934	1.1523	2.42

2