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A COMPUTER PROGRAM FOR FLOW CALCULATIONS

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1. ABSTRACT

This report describes a computer program for precise calculation of liquid, gas, steam, and vapor flows for flange, pipe, corner, radius, vena contracta, and venturi taps when used with a dry meter, a dry-calibrated mercury meter, a wet-calibrated mercury meter, or a U-tube manometer. The program provides an option of specifying either the orifice diameter or the maximum flow desired.

The program assumes that the pipe size and meter range have been selected in advance. Also required as input data are the physical properties and flowing conditions of the fluid.

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2. INTRODUCTION

With this Fortran program, flow of liquid, gas, steam, or vapor can be calculated precisely (six or more significant digits versus 1/2% for slide-rule calculations of empirical equations) for flange, pipe, corner, radius, vena contracta, or venturi taps.

The basic empirical equations are those proposed by the American Gas Association (AGA)[1] and the ASME Research Committee on Fluid Meters.[2] The definitions of the factors for a particular fluid calculation represent a compromise among those proposed by the American Meter Company in their E2 Handbook,[3] by Spink in Principles and Practice of Flow Meter Engineering,[4] and in the AGA and ASME reports previously mentioned. The definitions of the factors used herein are common to all types of calculations and make computation easier.

The program will compute flows at 100 points equidistant along the differential pressure scale, applying the exact Reynolds number factor and expansion factor at each point. The program provides an option of specifying either the orifice diameter or the maximum flow desired in pounds per hour.

3. DATA CARD KEYPUNCH FORMAT

The input data are punched on IBM cards according to the Data Card Keypunch Format (Figs. 1-5). The entries labeled Title, File No., Bldg. No., and Dept. in Figs. 1-5 will accept alphanumeric data; all other entries are numeric.

The entries labeled Meter Type, Tap Type, and Fluid Type are integer entries and are selected from the key shown at the bottom of the format sheet.

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[1] Orifice Metering of Natural Gas, Gas Measurement Assoc. Rept. No. 3, Am. Gas Assoc., April, 1955.

[2] Fluid Meters, Their Theory and Application, Rept. of ASME Research Comm. on Fluid Meters, 5th ed., Am. Soc. Mech. Engr., New York, 1959.

[3] J.C. Diehl, Orifice Meter Constants, Handbook E-2, American Meter Co., Inc., 1955.

[4] L.K. Spink, Principles and Practice of Flow Meter Engineering, 8th ed., Plimpton Press, Norwood, Mass., 1958.

The arrangements of factors for the liquid, gas, steam, and vapor calculations are:

1. For liquid

$$GPH = FB \cdot FR \cdot FA \cdot FM \cdot FGT \cdot EXT$$

2. For gas

$$SCFH = FB \cdot FR \cdot FA \cdot FM \cdot FPB \cdot FTB \cdot FTF \cdot FG \cdot FPV \cdot Y2 \cdot EXT$$

3. For steam and vapor

$$PPH = FB \cdot FR \cdot FA \cdot FM \cdot FS \cdot Y2 \cdot EXT$$

The steam and vapor calculations are identical; the only difference is the label. Vapor calculations may be accommodated within the framework of the gas calculations; however, the gas calculation requires a suitably defined supercompressibility factor, which is difficult to determine if the vapor is wet. It is, perhaps, a little more straightforward in such cases to use the vapor calculation, which requires a knowledge of the specific volume of the saturated vapor and the quality factor of the wet gas. If the steam or vapor is saturated or superheated, the specific volume of the steam or vapor at downstream conditions is entered as input data. If the steam or vapor is wet, the specific volume of the saturated steam or vapor at downstream conditions is first multiplied by the quality factor and this "adjusted specific volume" is entered as input data.

4. DEFINITION OF VARIABLES

D1	pipe ID, in.
D2	orifice ID, in.
B	D2/D1
R	meter reading, in.
H	differential pressure, in. H_2O at $60^\circ F$
P2	downstream pressure, psig
TF	temperature of fluid at flowing conditions, $^\circ F$
V2	downstream specific volume, ft^3/lb
SG	specific gravity of gas, relative to air
GB	base specific gravity of liquid at $60^\circ F$, relative to H_2O at $60^\circ F$

GF specific gravity of fluid at flowing conditions, relative to H_2O at 60^oF

GM specific gravity of manometer fluid, relative to H_2O at 60^oF

GS specific gravity of sealing fluid in contact with manometer fluid, relative to H_2O at 60^oF

VIS viscosity of fluid at flowing conditions, centipoises

K specific heat ratio of gas, steam, or vapor

PA average barometric pressure, psia

PB pressure base, psia

TB temperature base, ^oF

RD1 pipe Reynolds number

RD2 orifice Reynolds number, RD1/B

PPH pounds per hour

GPH gallons per hour

SCFH standard cubic feet per hour at pressure base and temperature base

5. DEFINITIONS OF FACTORS

5.1 FB, Basic Orifice Factor

For all tap types

$$FB = 338.17\ K_o\ (D2)^2\ ,$$

where K_o is defined by the following equations for various tap types.

For flange taps

$$K_o = \left\{0.5993 + \frac{0.007}{D1} + \left(0.364 + \frac{0.076}{(D1)^{1/2}}\right) B^4 + 0.4\left(1.6 - \frac{1}{D1}\right)^5\left(0.07 + \frac{0.5}{D1} - B\right)^{5/2}\right.$$

$$\left. - \left(0.009 + \frac{0.034}{D1}\right)\left(0.5 - B\right)^{3/2} + \left[\frac{65}{(D1)^2} + 3\right] + (B - 0.7)^{5/2}\right\}$$

$$\Big/ \left\{1 + 0.000015\ \frac{E}{D2}\right\}\ ,$$

where

$$E = D2\left(830 - 5000B + 9000B^2 - 4200B^3 + \frac{530}{(D1)^{1/2}}\right).$$

For pipe taps

$$K_o = \left[0.5925 + \frac{0.0182}{D1} + \left(0.44 - \frac{0.06}{D1}\right)B^2 + \left(0.935 + \frac{0.225}{D1}\right)B^5 + 1.35B^{14} + \frac{1.43}{(D1)^{1/2}}(0.25 - B)^{5/2}\right] \Big/ \left[1 + 0.000015\,\frac{E}{D2}\right],$$

where

$$E = D2\left(905 - 5000B + 9000B^2 - 4200B^3 + \frac{875}{D1}\right).$$

For corner taps

$$K_o = 0.6004 + 0.35B^4 - 0.052\,(0.5 - B)^{3/2} + 0.62\,(B - 0.7)^{5/3},$$

where

$$E = (0.002 + 0.026B^4)\,K_o^2.$$

For vena contracta taps

$$K_o = 0.5922 + 0.4252\left[\frac{0.0006}{(D1)^2B^2 + 0.01D1} + B^4 + 1.25B^{16}\right],$$

where

$$E = 0.00025 + 0.002325\,(B + 1.75B^4 + 10B^{12} + 2D1B^{16}).$$

For radius taps

$$K_o = 0.6014 - \frac{0.01352}{(D1)^{1/4}} + \left[0.376 + \frac{0.07257}{(D1)^{1/4}}\right]\left[\frac{0.00025}{(D1)^2B^2 + 0.0025D1} + B^4 + 1.5B^{16}\right],$$

where

$$E = 0.0002 + \frac{0.0011}{D1} + \left(0.0038 + \frac{0.0004}{D1}\right)\left[B^2 + (16.5 + 5D1)B^{16}\right].$$

For venturi taps

$$K_o = 0.984 \Big/ (1 - B^4)^{1/2} .$$

5.2 FR, Reynolds Number Factor

To calculate the Reynolds number factor, an intermediate quantity is first calculated, which is the quotient of the pipe Reynolds number divided by the Reynolds number factor. This intermediate quantity is defined for liquid, gas, steam, and vapor in the following equations.

For liquid

$$RD1/FR = \frac{17{,}920 D1\ K_o\ B^2 (H\ GF)^{1/2}}{VIS} .$$

For gas

$$RD1/FR = \frac{3730 D1\ FPV\ K_o\ B^2\ [H(P2 + PA)\ SG]^{1/2}}{VIS(TF + 459.67)^{1/2}} .$$

For steam and vapor

$$RD1/FR = \frac{2268.07 D1\ K_o B^2\ H^{1/2}}{VIS(V2)^{1/2}} .$$

The Reynolds number factor is then calculated for the various types of taps as defined in the following equations. (E is calculated according to the equations given in Sect 5.1, "FB, Basic Orifice Factor.")

For flange and pipe taps

$$FR = \frac{1}{2} + \frac{1}{2}\left(1 + \frac{4BE}{RD1/FR}\right)^{1/2} .$$

For corner, vena contracta, and radius taps

$$FR = 1 + \frac{1000E}{K_o[FR(RD1/FR)]^{1/2}} .$$

These two equations for FR are inaccurate for Reynolds numbers less than approximately 15,000. The program does not consider this fact except for flange and corner taps. For these taps and Reynolds numbers less than 15,000 (full scale), a special subroutine is entered to calculate the Reynolds number factor.

For venturi taps

$$FR = 1 \text{ (for all Reynolds numbers).}$$

This condition (FR = 1) is not true for Reynolds numbers less than 250,000, but this program does not consider this fact.

5.3 FA, Plate Expansion Factor

This factor corrects for orifice plate expansion due to temperature. The factor is entered as input data. It may be evaluated from the equation $FA = 1 + 2\alpha\Delta t$, where α is the coefficient of linear expansion of the orifice plate material and Δt is the difference between the flowing stream temperature and the ambient temperature.

5.4 FM, Manometer Factor

This factor corrects for the difference between the meter reading in inches and the differential pressure in inches of water at the taps. The definitions, each different for the various types of meters used to measure differential pressure, are given by the following equations.

For dry-type meters

$$FM = 1 .$$

For mercury meters, dry calibrated

$$FM = \left(1 - \frac{GS}{13.570667}\right)^{1/2} .$$

For mercury meters, wet calibrated

$$FM = 1 .$$

For U-tube manometers

$$FM = (GM - GS)^{1/2} .$$

In these definitions, the relationship between the meter reading R and the differential pressure H is in all cases

$$H^{1/2} = FM\ R^{1/2} .$$

For meters installed vertically on liquid service and having gas-purged leads, an additional correction must be made. This correction amounts to a zero shift, which is not accounted for in the equations for manometer factors. The zero-shift correction is equal to the actual vertical difference (in inches) between the taps multiplied by the specific gravity of the flowing liquid.

5.5 FGT, Specific Gravity-Temperature Factor

For liquid only, the specific gravity-temperature factor is

$$FGT = 1.0057 \frac{(GF)^{1/2}}{GB} .$$

5.6 FS, Steam Factor

For steam and vapor only, the steam factor is

$$FS = \frac{1.0618}{[V2(P2 + PA)]^{1/2}} .$$

5.7 FPB, Pressure Base Factor

For gas only, the pressure base factor is

$$FPB = \frac{14.73}{PB} .$$

5.8 FTB, Temperature Base Factor

For gas only, the temperature base factor is

$$FTB = \frac{459.67 + TB}{519.67} .$$

5.9 FTF, Flowing Temperature Factor

For gas only, the flowing temperature factor is

$$FTF = \left(\frac{519.67}{TF + 459.67}\right)^{1/2} .$$

5.10 FG, Specific Gravity Factor

For gas only, the specific gravity factor is

$$FG = SG^{-1/2}.$$

5.11 FPV, Supercompressibility Factor

This factor is for gas only, and is normally entered as input data. For natural gas, a special subroutine is optional, by which the supercompressibility factor is calculated from formulas developed by the California Natural Gas Association.[5] For this option, the value 9.0 is entered as input for the supercompressibility factor. The program will calculate a supercompressibility factor based on the following formulas:

1. for $SG \leq 0.75$

$$FPV = \left[1 + \frac{P2(3.444 \times 10^5)10^{1.785SG}}{(TF + 459.67)^{3.825}}\right]^{1/2}.$$

2. for $SG > 0.75$

$$FPV = \left[1 + \frac{P2(9.16 \times 10^5)10^{1.188SG}}{(TF + 459.67)^{3.825}}\right]^{1/2}.$$

5.12 Y2, Expansion Factor

For gas, steam, and vapor only,

$$Y2 = Y1(1 - X1)^{-1/2},$$

where

$$X1 = \frac{H/(P2 + PA)}{27.7 + [H/(P2 + PA)]},$$

and Y1 is defined for the various types of taps in the following equations.

For flange, corner, vena contracta, and radius taps

$$Y1 = 1 - (0.41 + 0.35B^4)\frac{X1}{K}.$$

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[5] Bulletin TS-402, California Natural Gasoline Assoc.

For pipe taps

$$Y1 = 1 - [0.333 + 1.145(B^2 + 0.7B^5 + 12B^{13})] \frac{X1}{K} .$$

For venturi taps

$$Y1 = \left[(R1)^{2/K} \left(\frac{K}{K - 1} \right) \frac{1 - R1^{(K-1)/K}}{1 - R1} \frac{1 - B^4}{1 - B^4 (R1)^{2/K}} \right]^{1/2} ,$$

where

$$R1 = \frac{P2 + PA}{P2 + (H/27.7) + PA} .$$

5.13 EXT, Extension Factor

For liquid

$$EXT = R^{1/2} ,$$

and for gas, steam, and vapor

$$EXT = [R(P2 + PA)]^{1/2} .$$

6. FLOW CALCULATION OUTPUT SHEET

A flow calculation output sheet for each problem described in Figs. 1-5 is given in Figs. 1a-5a. Although the normal readouts are readily understood from the discussion in the previous sections of this report, the auxiliary readouts are described in the following discussion.

The "C Factor" is the product of all factors making up a given flow calculation except the extension factor.

The "SR10 Factor" for liquid flows is the midscale flow multiplied by $(2)^{1/2}/10$ and is expressed in units of PPH per division and GPH per division. This factor is useful when square root charts graduated into 10 chart divisions are used.

The "Conversion Factor" for liquid flows is the base gravity multiplied by 8.3282607 and is expressed in units of pounds per gallon.

The "Conversion Factor" for gas flows is $0.370214\ (TB + 459.67)/PB \cdot SG$ and is expressed in units of standard cubic feet per pound.

Since the definition for the gas conversion factor used by the computer to provide an auxiliary readout in weight units (PPH) will be in error at times because of the different definitions used for SG and FPV, the following discussion is presented.

Let Z = compressibility in general
b = base conditions
f = flowing conditions
Mw = average molecular weight of gas mixture

then

$$Z_b = \frac{P_b \, V_b}{R \, T_b}$$

and

$$Z_f = \frac{P_f \, V_f}{R \, T_f} ,$$

where

P = psia
V = ft^3/lb-mole
T = ^oR
R = 10.73, gas constant.

For volume units of measurement, or SCFH,

$$FPV = \frac{Z_b}{(Z_f)^{1/2}} , \text{ if } SG = M_w/29 ; \qquad (1)$$

$$FPV = \left(\frac{Z_b}{Z_f}\right)^{1/2} , \text{ if } SG = M_w/29Z_b \qquad (2)$$

For weight units of measurement, or PPH,

$$FPV = \frac{1}{(Z_f)^{1/2}} , \text{ if } SG = M_w/29 ; \qquad (3)$$

$$FPV = \left(\frac{Z_b}{Z_f}\right)^{1/2} , \text{ if } SG = M_w/29Z_b . \qquad (4)$$

If SG is calculated from molecular weight and mole fraction data and is entered in the computer program, the FPV factor entered should be calculated from the corresponding Eqs. 1 and 3. Since these formulas are not the same for both volume and weight units, the readout from the computer will be exact only for those calculations for which the FPV factor entry is appropriate. The readout for other calculations will be in error depending on the deviation of Z_b from unity. Since Z_b is nearly equal to unity in cases dealing with the so called "permanent" gases, the error will be negligible in these cases.

If SG is measured by use of a gravitometer at close to base conditions, Eqs. 2 and 4 should be used. Compressibility at base conditions affects the measurement of SG, as shown in Eqs. 2 and 4. These two equations are identical for both volume and weight units. The computer, which reads out both volume and weight units, can be correct for both cases only if FPV is defined as in Eqs. 2 and 4 and SG is measured with a gravitometer at base conditions.

The program will automatically make certain substitutions if a zero is entered as an input. These substitutions are

VIS	= 1.	centipoise (for liquid)
	= 0.0103	centipoise (for gas and vapor)
	= 0.0192	centipoise (for steam)
K	= 1.3	(for gas and vapor)
	= 1.298	(for steam)
PB	= 14.73	psig (for gas)
TB	= 60°F	(for gas)
PA	= 14.323	

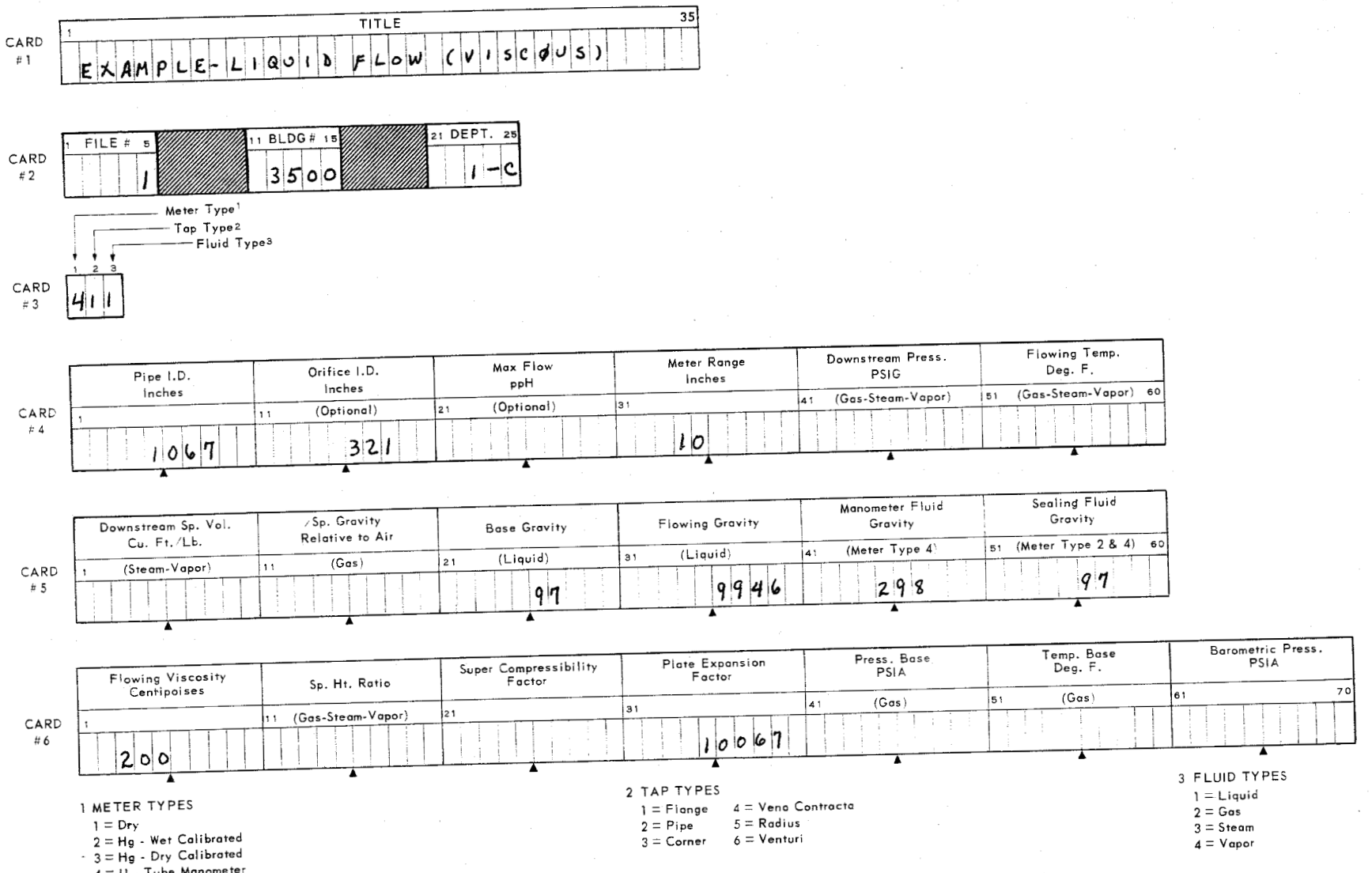

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Fig. 1. Flow Calculation Input Data for Liquid Flow (Viscous).

FILE NO. 1

FLOW CALCULATION

EXAMPLE-LIQUID FLOW (VISCOUS)
BLDG. NO. 3500
DEPT. NO. I-C

METER = 4
TAPS = 1
FLUID = 1

PIPE ID	=	1.0670 INCHES
ORIFICE ID	=	.3210 INCHES
BETA	=	.3008 DIAMETER RATIO
METER RANGE	=	10.0 INCHES
VISCOSITY	=	200.0000 CENTIPOISES (FLOWING)
ORIFICE REY. NO.	=	60 MIDSCALE
GM	=	2.9800 MANOMETER FLUID GRAVITY
GS	=	.9700 SEALING FLUID GRAVITY
GB	=	.9700 BASE GRAVITY
GF	=	.9946 FLOWING GRAVITY
SRIO FACTOR	=	10.80 GALLONS PER HOUR PER DIVISION
SRIO FACTOR	=	87.3 POUNDS PER HOUR PER DIVISION
CONVERSION FACTOR	=	8.07841 POUNDS PER GALLON

FB	=	20.98920
FR	=	1.10264 MIDSCALE
FA	=	1.00670
FM	=	1.41774
FGT	=	1.03400
C	=	34.15459

METER READING INCHES	DIFF PRESS INCHES H20	PPH	GPH
1.0	2.01	258.16	31.96
2.0	4.02	367.66	45.51
3.0	6.03	464.09	57.45
4.0	8.04	545.40	67.51
5.0	10.05	616.96	76.37
6.0	12.06	681.58	84.37
7.0	14.07	740.90	91.71
8.0	16.08	796.03	98.54
9.0	18.09	847.73	104.94
10.0	20.10	896.55	110.98

METER 1 = DRY
2 = HG, DRY CAL.
3 = HG, WET CAL.
4 = U-TUBE MAN.

TAPS 1 = FLANGE
2 = PIPE
3 = CORNER
4 = VENA CONTRACTA
5 = RADIUS
6 = VENTURI

FLUID 1 = LIQUID
2 = GAS
3 = STEAM
4 = VAPOR

Fig. 1a. Flow Calculation Output Data for Liquid Flow (Viscous).

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
1	.32	34.3	10.3	1.03168	-0	-0
2	.45	34.3	10.3	1.03168	-0	-0
3	.55	34.3	10.3	1.03168	-0	-0
4	.63	34.3	10.3	1.03168	-0	-0
5	.71	34.3	10.3	1.03168	-0	-0
6	.77	34.3	10.3	1.03168	-0	-0
7	.84	34.3	10.3	1.03168	-0	-0
8	.89	34.3	10.3	1.03168	-0	-0
9	.95	34.3	10.3	1.03168	-0	-0
10	1.00	34.3	10.3	1.03168	-0	-0
11	1.05	34.3	10.3	1.03168	-0	-0
12	1.10	34.3	10.3	1.03168	-0	-0
13	1.14	34.3	10.3	1.03168	-0	-0
14	1.18	34.3	10.3	1.03168	-0	-0
15	1.22	34.3	10.3	1.03168	-0	-0
16	1.26	34.3	10.3	1.03168	-0	-0
17	1.30	34.3	10.3	1.03168	-0	-0
18	1.34	34.3	10.3	1.03168	-0	-0
19	1.38	34.9	10.5	1.03446	-0	-0
20	1.41	36.0	10.8	1.03893	-0	-0
21	1.45	37.0	11.1	1.04309	-0	-0
22	1.48	38.0	11.4	1.04697	-0	-0
23	1.52	39.0	11.7	1.05060	-0	-0
24	1.55	40.0	12.0	1.05401	-0	-0
25	1.58	40.9	12.3	1.05721	-0	-0
26	1.61	41.9	12.6	1.06023	-0	-0
27	1.64	42.8	12.9	1.06308	-0	-0
28	1.67	43.7	13.1	1.06578	-0	-0
29	1.70	44.6	13.4	1.06834	-0	-0
30	1.73	45.4	13.7	1.07077	-0	-0
31	1.76	46.3	13.9	1.07308	-0	-0
32	1.79	47.1	14.2	1.07529	-0	-0
33	1.82	47.9	14.4	1.07739	-0	-0
34	1.84	48.8	14.7	1.07940	-0	-0
35	1.87	49.6	14.9	1.08131	-0	-0
36	1.90	50.3	15.1	1.08315	-0	-0
37	1.92	51.1	15.4	1.08491	-0	-0
38	1.95	51.9	15.6	1.08660	-0	-0
39	1.97	52.6	15.8	1.08823	-0	-0
40	2.00	53.4	16.1	1.08979	-0	-0
41	2.02	54.1	16.3	1.09129	-0	-0
42	2.05	54.9	16.5	1.09274	-0	-0
43	2.07	55.6	16.7	1.09413	-0	-0
44	2.10	56.3	16.9	1.09548	-0	-0
45	2.12	57.0	17.1	1.09677	-0	-0
46	2.14	57.7	17.4	1.09803	-0	-0
47	2.17	58.4	17.6	1.09924	-0	-0
48	2.19	59.1	17.8	1.10041	-0	-0
49	2.21	59.7	18.0	1.10154	-0	-0
50	2.24	60.4	18.2	1.10264	-0	-0

Fig. 1a (continued)

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
51	2.26	61.1	18.4	1.10371	-0	-0
52	2.28	61.7	18.6	1.10474	-0	-0
53	2.30	62.4	18.8	1.10574	-0	-0
54	2.32	63.0	19.0	1.10671	-0	-0
55	2.35	63.6	19.1	1.10765	-0	-0
56	2.37	64.3	19.3	1.10857	-0	-0
57	2.39	64.9	19.5	1.10946	-0	-0
58	2.41	65.5	19.7	1.11032	-0	-0
59	2.43	66.1	19.9	1.11116	-0	-0
60	2.45	66.7	20.1	1.11198	-0	-0
61	2.47	67.3	20.3	1.11278	-0	-0
62	2.49	67.9	20.4	1.11355	-0	-0
63	2.51	68.5	20.6	1.11431	-0	-0
64	2.53	69.1	20.8	1.11505	-0	-0
65	2.55	69.7	21.0	1.11576	-0	-0
66	2.57	70.3	21.1	1.11646	-0	-0
67	2.59	70.8	21.3	1.11715	-0	-0
68	2.61	71.4	21.5	1.11781	-0	-0
69	2.63	72.0	21.7	1.11847	-0	-0
70	2.65	72.5	21.8	1.11910	-0	-0
71	2.66	73.1	22.0	1.11972	-0	-0
72	2.68	73.6	22.2	1.12033	-0	-0
73	2.70	74.2	22.3	1.12092	-0	-0
74	2.72	74.7	22.5	1.12150	-0	-0
75	2.74	75.3	22.6	1.12206	-0	-0
76	2.76	75.8	22.8	1.12262	-0	-0
77	2.77	76.3	23.0	1.12316	-0	-0
78	2.79	76.9	23.1	1.12369	-0	-0
79	2.81	77.4	23.3	1.12421	-0	-0
80	2.83	77.9	23.4	1.12472	-0	-0
81	2.85	78.4	23.6	1.12521	-0	-0
82	2.86	79.0	23.8	1.12570	-0	-0
83	2.88	79.5	23.9	1.12618	-0	-0
84	2.90	80.0	24.1	1.12664	-0	-0
85	2.92	80.5	24.2	1.12710	-0	-0
86	2.93	81.0	24.4	1.12755	-0	-0
87	2.95	81.5	24.5	1.12799	-0	-0
88	2.97	82.0	24.7	1.12842	-0	-0
89	2.98	82.5	24.8	1.12884	-0	-0
90	3.00	83.0	25.0	1.12926	-0	-0
91	3.02	83.5	25.1	1.12966	-0	-0
92	3.03	84.0	25.3	1.13006	-0	-0
93	3.05	84.4	25.4	1.13046	-0	-0
94	3.07	84.9	25.6	1.13084	-0	-0
95	3.08	85.4	25.7	1.13122	-0	-0
96	3.10	85.9	25.8	1.13159	-0	-0
97	3.11	86.4	26.0	1.13195	-0	-0
98	3.13	86.8	26.1	1.13231	-0	-0
99	3.15	87.3	26.3	1.13266	-0	-0
100	3.16	87.8	26.4	1.13301	-0	-0

Fig. 1a (continued)

EXAMPLE-LIQUID FLOW (VISCOUS)
PIPE ID = 1.067 INCHES
ORIF. ID = .321 INCHES

BASE GRAVITY = .9730 (60 F)
FLOWING GRAVITY = .9946
RANGE = 10.0 INCHES

PER CENT FULL SCALE	PPH	GPH
1	81.637	10.1055
2	115.452	14.2914
3	141.399	17.5033
4	163.274	20.2111
5	182.545	22.5967
6	199.968	24.7534
7	215.991	26.7368
8	230.904	28.5828
9	244.910	30.3166
10	258.158	31.9565
11	270.759	33.5163
12	282.798	35.0066
13	294.346	36.4361
14	305.457	37.8115
15	316.178	39.1386
16	326.547	40.4222
17	336.597	41.6662
18	346.355	42.8742
19	356.806	44.1679
20	367.658	45.5112
21	378.246	46.8218
22	388.587	48.1019
23	398.698	49.3535
24	408.593	50.5784
25	418.286	51.7782
26	427.788	52.9544
27	437.109	54.1085
28	446.261	55.2411
29	455.250	56.3539
30	464.086	57.4477
31	472.776	58.5234
32	481.327	59.5819
33	489.745	60.6239
34	498.036	61.6503
35	506.206	62.6615
36	514.259	63.6584
37	522.200	64.6415
38	530.035	65.6112
39	537.766	66.5682
40	545.398	67.5130
41	552.934	68.4459
42	560.378	69.3673
43	567.733	70.2778
44	575.002	71.1777
45	582.189	72.0672
46	589.295	72.9468
47	596.323	73.8168
48	603.276	74.6775
49	610.155	75.5291
50	616.964	76.3720
51	623.705	77.2064
52	630.378	78.0325
53	636.987	78.8505
54	643.533	79.6608
55	650.017	80.4635
56	656.442	81.2588
57	662.809	82.0469
58	669.119	82.8280
59	675.374	83.6023
60	681.575	84.3699
61	687.724	85.1311
62	693.822	85.8859
63	699.870	86.6345
64	705.869	87.3771
65	711.820	88.1138
66	717.725	88.8448
67	723.584	89.5701
68	729.399	90.2899
69	735.170	91.0043
70	740.899	91.7134
71	746.586	92.4174
72	752.232	93.1163
73	757.838	93.8103
74	763.406	94.4995
75	768.934	95.1838
76	774.425	95.8636
77	779.880	96.5387
78	785.298	97.2094
79	790.681	97.8757
80	796.028	98.5377
81	801.342	99.1955
82	806.622	99.8491
83	811.869	100.4986
84	817.084	101.1442
85	822.267	101.7858
86	827.419	102.4235
87	832.541	103.0575
88	837.632	103.6877
89	842.693	104.3142
90	847.726	104.9372
91	852.729	105.5566
92	857.705	106.1725
93	862.653	106.7849
94	867.573	107.3940
95	872.467	107.9998
96	877.334	108.6023
97	882.176	109.2016
98	886.991	109.7977
99	891.782	110.3907
100	896.547	110.9806

Fig. 1a (continued)

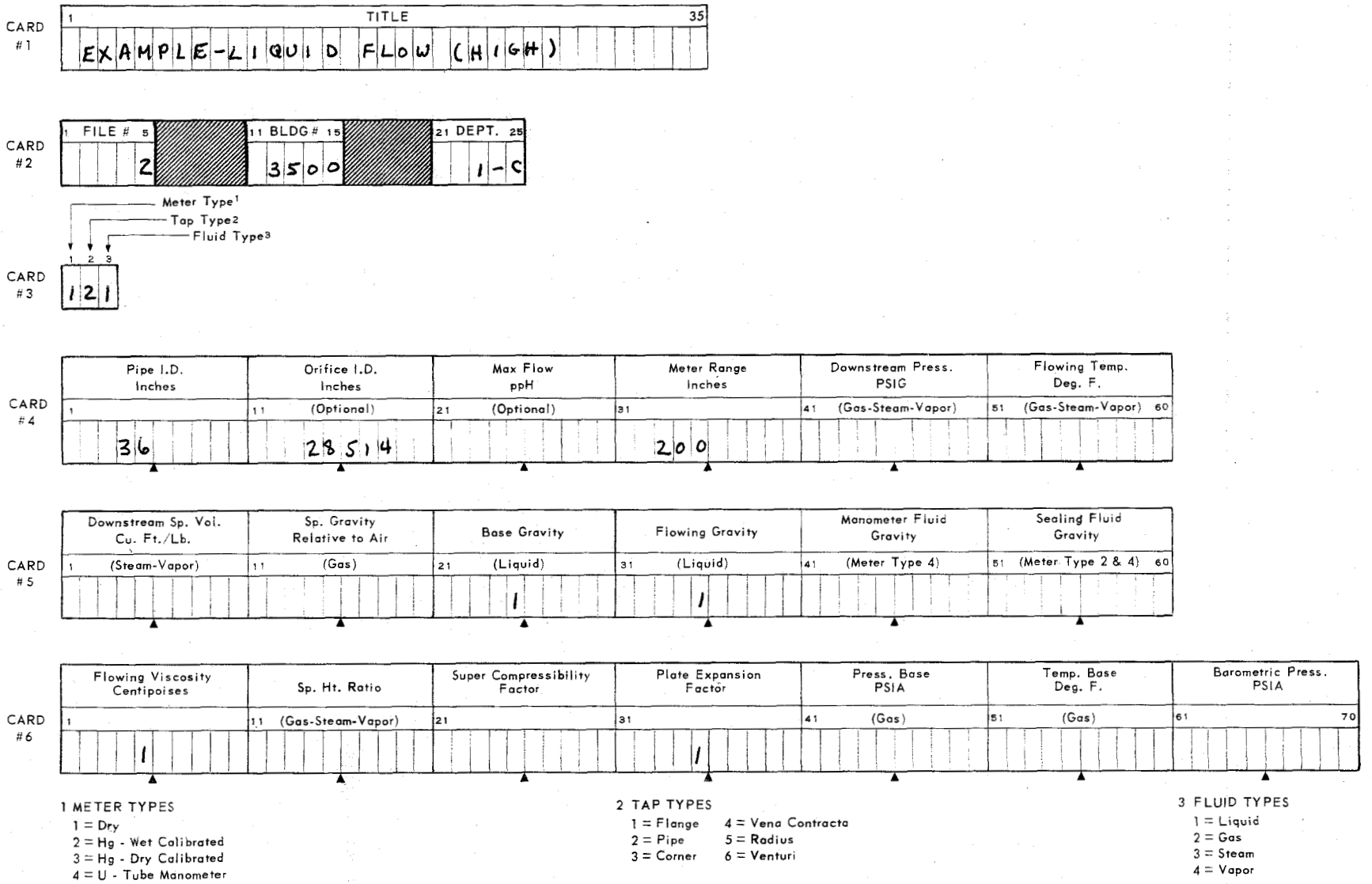


Fig. 2. Flow Calculation Input Data for Liquid Flow (High).

FILE NO. 2

FLOW CALCULATION

EXAMPLE-LIQUID FLOW (HIGH)
BLDG. NO. 3500
DEPT. NO. I-C

METER = 1
TAPS = 2
FLUID = 1

PIPE ID = 36.0000 INCHES
ORIFICE ID = 28.5140 INCHES
BETA = .7921 DIAMETER RATIO
METER RANGE = 200.0 INCHES
VISCOSITY = 1.0000 CENTIPOISES (FLOWING)
ORIFICE REY. NO. = 6165907MIDSCALE
GB = 1.0000 BASE GRAVITY
GF = 1.0000 FLOWING GRAVITY
SRIO FACTOR =71884.5* GALLONS PER HOUR PER DIVISION
SRIO FACTOR =929977.* POUNDS PER HOUR PER DIVISION
CONVERSION FACTOR = 8.32826 POUNDS PER GALLON

FB = 330973.01108
FR = 1.00244 MIDSCALE
FA = 1.00000
FM = 1.00000
FGT = 1.00570

C = 333672.65314

METER READING INCHES	DIFF PRESS INCHES H20	PPH	GPH
20.0	20.00	12464906.68	1496699.87
40.0	40.00	17600181.53	2113308.19
60.0	60.00	21540582.08	2586444.26
80.0	80.00	24862481.72	2985315.02
100.0	100.00	27789128.44	3336726.53
120.0	120.00	30435016.12	3654426.44
140.0	140.00	32868158.91	3946581.42
160.0	160.00	35132871.62	4218512.47
180.0	180.00	37259935.31	4473915.58
200.0	200.00	39271761.42	4715481.76

METER 1 = DRY
2 = HG. DRY CAL.
3 = HG. WET CAL.
4 = U-TUBE MAN.

TAPS 1 = FLANGE
2 = PIPE
3 = CORNER
4 = VENA CONTRACTA
5 = RADIUS
6 = VENTURI

FLUID 1 = LIQUID
2 = GAS
3 = STEAM
4 = VAPOR

Fig. 2a. Flow Calculation Output Data for Liquid Flow (High).

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
1	1.41	884675.7	700712.3	1.01703	-0	-0
2	2.00	1245058.1	986155.2	1.01210	-0	-0
3	2.45	1521566.3	1205165.1	1.00990	-0	-0
4	2.83	1754665.7	1389792.7	1.00858	-0	-0
5	3.16	1960026.5	1552449.9	1.00768	-0	-0
6	3.46	2145684.7	1699501.5	1.00702	-0	-0
7	3.74	2316413.7	1834728.3	1.00650	-0	-0
8	4.00	2475323.4	1960593.6	1.00608	-0	-0
9	4.24	2624573.9	2078808.4	1.00574	-0	-0
10	4.47	2765738.1	2190618.2	1.00545	-0	-0
11	4.69	2900003.2	2296963.6	1.00519	-0	-0
12	4.90	3028291.5	2398575.1	1.00497	-0	-0
13	5.10	3151336.7	2496033.7	1.00478	-0	-0
14	5.29	3269733.3	2589810.5	1.00461	-0	-0
15	5.48	3383971.7	2680293.6	1.00445	-0	-0
16	5.66	3494461.2	2767807.4	1.00431	-0	-0
17	5.83	3601548.5	2852626.5	1.00418	-0	-0
18	6.00	3705529.8	2934985.5	1.00406	-0	-0
19	6.16	3806660.5	3015086.6	1.00396	-0	-0
20	6.32	3905163.0	3093106.1	1.00386	-0	-0
21	6.48	4001232.2	3169198.2	1.00376	-0	-0
22	6.63	4095039.9	3243499.1	1.00368	-0	-0
23	6.78	4186738.7	3316129.6	1.00360	-0	-0
24	6.93	4276464.7	3387197.6	1.00352	-0	-0
25	7.07	4364340.1	3456799.8	1.00345	-0	-0
26	7.21	4450474.8	3525023.3	1.00338	-0	-0
27	7.35	4534968.3	3591946.9	1.00332	-0	-0
28	7.48	4617911.1	3657642.2	1.00326	-0	-0
29	7.62	4699385.5	3722174.4	1.00321	-0	-0
30	7.75	4779466.9	3785603.3	1.00315	-0	-0
31	7.87	4858224.3	3847983.5	1.00310	-0	-0
32	8.00	4935721.2	3909365.4	1.00305	-0	-0
33	8.12	5012016.5	3969795.5	1.00301	-0	-0
34	8.25	5087164.2	4029316.7	1.00296	-0	-0
35	8.37	5161214.7	4087968.8	1.00292	-0	-0
36	8.49	5234214.7	4145788.8	1.00288	-0	-0
37	8.60	5306207.6	4202811.2	1.00284	-0	-0
38	8.72	5377234.0	4259068.0	1.00280	-0	-0
39	8.83	5447331.8	4314589.4	1.00276	-0	-0
40	8.94	5516536.5	4369403.4	1.00273	-0	-0
41	9.06	5584881.5	4423536.4	1.00270	-0	-0
42	9.17	5652397.9	4477013.1	1.00266	-0	-0
43	9.27	5719115.2	4529856.9	1.00263	-0	-0
44	9.38	5785061.1	4582089.8	1.00260	-0	-0
45	9.49	5850261.7	4633732.3	1.00257	-0	-0
46	9.59	5914741.9	4684804.2	1.00255	-0	-0
47	9.70	5978524.9	4735323.9	1.00252	-0	-0
48	9.80	6041632.9	4785308.9	1.00249	-0	-0
49	9.90	6104086.8	4834775.9	1.00247	-0	-0
50	10.00	6165906.7	4883740.6	1.00244	-0	-0

Fig. 2a. (continued)

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
51	10.10	6227111.3	4932218.1	1.00242	-0	-0
52	10.20	6287718.8	4980222.6	1.00240	-0	-0
53	10.30	6347746.3	5027767.7	1.00237	-0	-0
54	10.39	6407210.1	5074866.4	1.00235	-0	-0
55	10.49	6466125.8	5121530.9	1.00233	-0	-0
56	10.58	6524508.3	5167773.1	1.00231	-0	-0
57	10.68	6582371.8	5213604.2	1.00229	-0	-0
58	10.77	6639729.9	5259035.0	1.00227	-0	-0
59	10.86	6696595.6	5304075.8	1.00225	-0	-0
60	10.95	6752981.5	5348736.5	1.00223	-0	-0
61	11.05	6808899.3	5393026.5	1.00221	-0	-0
62	11.14	6864360.7	5436955.0	1.00219	-0	-0
63	11.22	6919376.5	5480530.6	1.00218	-0	-0
64	11.31	6973957.5	5523761.7	1.00216	-0	-0
65	11.40	7028113.6	5566656.4	1.00214	-0	-0
66	11.49	7081854.7	5609222.4	1.00213	-0	-0
67	11.58	7135190.3	5651467.1	1.00211	-0	-0
68	11.66	7188129.2	5693397.7	1.00210	-0	-0
69	11.75	7240680.3	5735021.1	1.00208	-0	-0
70	11.83	7292852.0	5776343.9	1.00207	-0	-0
71	11.92	7344652.3	5817372.7	1.00205	-0	-0
72	12.00	7396089.1	5858113.4	1.00204	-0	-0
73	12.08	7447169.9	5898572.3	1.00202	-0	-0
74	12.17	7497902.0	5938754.9	1.00201	-0	-0
75	12.25	7548292.5	5978667.0	1.00200	-0	-0
76	12.33	7598348.1	6018313.8	1.00198	-0	-0
77	12.41	7648075.5	6057700.7	1.00197	-0	-0
78	12.49	7697481.0	6096832.6	1.00196	-0	-0
79	12.57	7746570.8	6135714.5	1.00194	-0	-0
80	12.65	7795350.9	6174351.0	1.00193	-0	-0
81	12.73	7843827.1	6212746.8	1.00192	-0	-0
82	12.81	7892004.9	6250906.3	1.00191	-0	-0
83	12.88	7939889.8	6288833.8	1.00190	-0	-0
84	12.96	7987487.2	6326533.6	1.00189	-0	-0
85	13.04	8034802.0	6364009.6	1.00187	-0	-0
86	13.11	8081839.3	6401265.7	1.00186	-0	-0
87	13.19	8128604.0	6438305.9	1.00185	-0	-0
88	13.27	8175100.6	6475133.9	1.00184	-0	-0
89	13.34	8221333.8	6511753.1	1.00183	-0	-0
90	13.42	8267308.0	6548167.2	1.00182	-0	-0
91	13.49	8313027.5	6584379.6	1.00181	-0	-0
92	13.56	8358496.4	6620393.5	1.00180	-0	-0
93	13.64	8403718.9	6656212.2	1.00179	-0	-0
94	13.71	8448698.9	6691838.9	1.00178	-0	-0
95	13.78	8493440.3	6727276.6	1.00177	-0	-0
96	13.86	8537946.8	6762528.2	1.00176	-0	-0
97	13.93	8582222.1	6797596.7	1.00176	-0	-0
98	14.00	8626269.7	6832484.9	1.00175	-0	-0
99	14.07	8670093.2	6867195.5	1.00174	-0	-0
100	14.14	8713695.9	6901731.3	1.00173	-0	-0

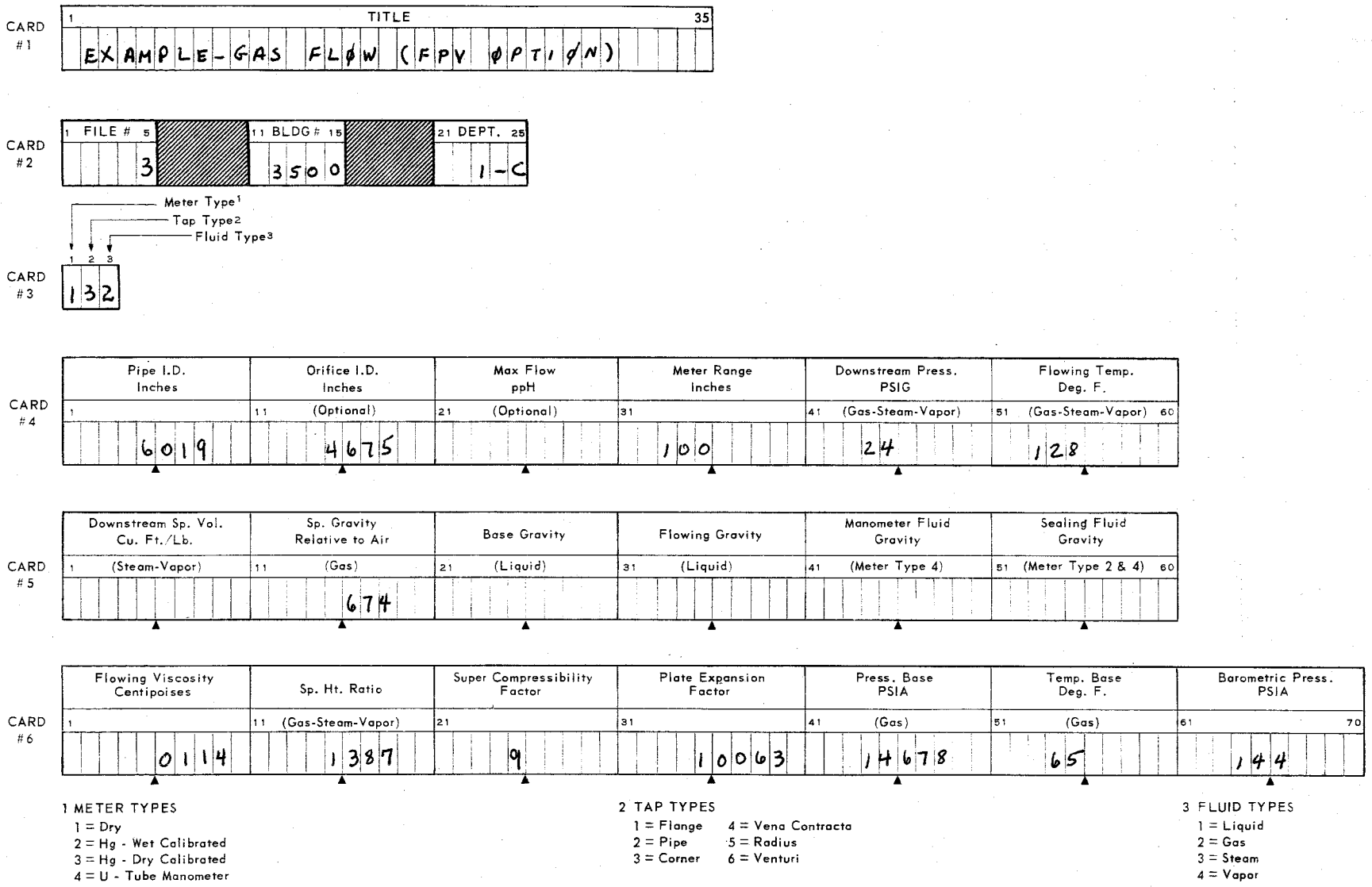
Fig. 2a. (continued)

EXAMPLE-LIQUID FLOW (HIGH)
PIPE ID = 36.000 INCHES
ORIF. ID = 28.514 INCHES

BASE GRAVITY = 1.0000 (60 F)
FLOWING GRAVITY = 1.0000
RANGE = 200.0 INCHES

PER CENT FULL SCALE	MM PPH	MM GPH	PER CENT FULL SCALE	MM PPH	MM GPH
1	3.987	.4787	51	28.065	3.3698
2	5.611	.6738	52	28.338	3.4026
3	6.858	.8234	53	28.609	3.4351
4	7.908	.9496	54	28.877	3.4673
5	8.834	1.0607	55	29.142	3.4992
6	9.670	1.1612	56	29.405	3.5308
7	10.440	1.2535	57	29.666	3.5621
8	11.156	1.3395	58	29.925	3.5931
9	11.829	1.4203	59	30.181	3.6239
10	12.465	1.4967	60	30.435	3.6544
11	13.070	1.5694	61	30.687	3.6847
12	13.648	1.6388	62	30.937	3.7147
13	14.203	1.7054	63	31.185	3.7445
14	14.736	1.7694	64	31.431	3.7740
15	15.251	1.8313	65	31.675	3.8033
16	15.749	1.8911	66	31.917	3.8324
17	16.232	1.9490	67	32.158	3.8613
18	16.700	2.0053	68	32.396	3.8899
19	17.156	2.0600	69	32.633	3.9183
20	17.600	2.1133	70	32.868	3.9466
21	18.033	2.1653	71	33.102	3.9746
22	18.456	2.2161	72	33.333	4.0024
23	18.869	2.2657	73	33.564	4.0301
24	19.274	2.3142	74	33.792	4.0575
25	19.670	2.3618	75	34.019	4.0848
26	20.058	2.4084	76	34.245	4.1119
27	20.439	2.4541	77	34.469	4.1388
28	20.812	2.4990	78	34.692	4.1655
29	21.180	2.5431	79	34.913	4.1921
30	21.541	2.5864	80	35.133	4.2185
31	21.896	2.6291	81	35.351	4.2447
32	22.245	2.6710	82	35.568	4.2708
33	22.589	2.7123	83	35.784	4.2967
34	22.927	2.7530	84	35.999	4.3225
35	23.261	2.7930	85	36.212	4.3481
36	23.590	2.8325	86	36.424	4.3735
37	23.915	2.8715	87	36.635	4.3989
38	24.235	2.9099	88	36.844	4.4240
39	24.551	2.9479	89	37.053	4.4490
40	24.862	2.9853	90	37.260	4.4739
41	25.171	3.0223	91	37.466	4.4987
42	25.475	3.0588	92	37.671	4.5233
43	25.775	3.0949	93	37.875	4.5477
44	26.073	3.1306	94	38.077	4.5721
45	26.367	3.1659	95	38.279	4.5963
46	26.657	3.2008	96	38.480	4.6204
47	26.945	3.2353	97	38.679	4.6443
48	27.229	3.2695	98	38.878	4.6682
49	27.511	3.3033	99	39.075	4.6919
50	27.789	3.3367	100	39.272	4.7155

Fig. 2a. (continued)



1 METER TYPES
1 = Dry
2 = Hg - Wet Calibrated
3 = Hg - Dry Calibrated
4 = U - Tube Manometer

2 TAP TYPES
1 = Flange
2 = Pipe
3 = Corner
4 = Vena Contracta
5 = Radius
6 = Venturi

3 FLUID TYPES
1 = Liquid
2 = Gas
3 = Steam
4 = Vapor

UCN-5801
(3 5-64)

Fig. 3. Flow Calculation Input Data for Gas Flow (FPV Option).

FILE NO. 3

FLOW CALCULATION

EXAMPLE-GAS FLOW (FPV OPTION)
BLDG. NO. 3500
DEPT. NO. I-C

METER = 1
TAPS = 3
FLUID = 2

PIPE ID	=	6.0190 INCHES
ORIFICE ID	=	4.6750 INCHES
BETA	=	.7767 DIAMETER RATIO
METER RANGE	=	100.0 INCHES
VISCOSITY	=	.0114 CENTIPOISES (FLOWING)
ORIFICE REY. NO.	=	1656595MIDSCALE
FLOWING PRESS	=	24.0 PSIG (DOWNSTREAM)
FLOWING TEMP	=	128.0 DEG. F
K	=	1.387 SPECIFIC HEAT RATIO
PRESS BASE	=	14.678 PSIA
TEMP BASE	=	65.0 DEG. F
SG	=	.6740 RELATIVE TO AIR
CONVERSION FACTOR	=	19.634 SCF / LB.

FB	=	5442.40988
FR	=	1.00737 MIDSCALE
FA	=	1.00630
FM	=	1.00000
FPB	=	1.00354
FTB	=	1.00962
FTF	=	.94037
FG	=	1.21806
FPV	=	1.00169
Y2	=	1.00543 MIDSCALE
C	=	6448.47513

METER READING INCHES	DIFF PRESS INCHES H20	PPH	SCFH
10.0	10.00	6431.05	126268.26
20.0	20.00	9088.95	178453.96
30.0	30.00	11133.91	218604.90
40.0	40.00	12863.01	252554.46
50.0	50.00	14391.15	282558.02
60.0	60.00	15777.13	309770.63
70.0	70.00	17055.86	334877.52
80.0	80.00	18250.07	358324.67
90.0	90.00	19375.49	380421.47
100.0	100.00	20443.60	401392.95

METER 1 = DRY
2 = HG, DRY CAL.
3 = HG, WET CAL.
4 = U-TUBE MAN.

TAPS 1 = FLANGE
2 = PIPE
3 = CORNER
4 = VENA CONTRACTA
5 = RADIUS
6 = VENTURI

FLUID 1 = LIQUID
2 = GAS
3 = STEAM
4 = VAPOR

Fig. 3a. Flow Calculation Output Data for Gas Flow (FPV Option).

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
1	6.20	241389.9	187489.3	1.01949	.99964	1.00011
2	8.76	340346.7	264349.7	1.01642	.99927	1.00021
3	10.73	416193.6	323260.5	1.01485	.99891	1.00032
4	12.39	480094.4	372892.7	1.01382	.99855	1.00042
5	13.86	536367.4	416600.3	1.01308	.99819	1.00053
6	15.18	587225.1	456101.9	1.01250	.99783	1.00064
7	16.40	633981.4	492417.9	1.01203	.99747	1.00074
8	17.53	677491.7	526212.6	1.01164	.99711	1.00085
9	18.59	718349.9	557947.5	1.01130	.99675	1.00096
10	19.60	756988.6	587958.4	1.01101	.99639	1.00106
11	20.55	793733.8	616498.7	1.01075	.99603	1.00117
12	21.47	828839.2	643765.3	1.01052	.99568	1.00128
13	22.34	862506.2	669914.7	1.01031	.99532	1.00139
14	23.19	894898.1	695073.7	1.01012	.99497	1.00149
15	24.00	926149.6	719346.9	1.00995	.99461	1.00160
16	24.79	956373.0	742821.7	1.00979	.99426	1.00171
17	25.55	985663.6	765571.9	1.00965	.99391	1.00182
18	26.29	1014102.7	787660.7	1.00951	.99355	1.00192
19	27.01	1041760.3	809142.6	1.00938	.99320	1.00203
20	27.71	1068697.5	830064.9	1.00926	.99285	1.00214
21	28.40	1094967.7	850469.2	1.00915	.99250	1.00225
22	29.07	1120618.2	870392.1	1.00905	.99215	1.00236
23	29.72	1145690.7	889866.1	1.00895	.99180	1.00247
24	30.36	1170222.7	908920.3	1.00885	.99145	1.00257
25	30.98	1194247.6	927580.6	1.00876	.99110	1.00268
26	31.60	1217795.5	945870.4	1.00868	.99076	1.00279
27	32.20	1240893.9	963811.1	1.00860	.99041	1.00290
28	32.79	1263567.4	981421.8	1.00852	.99006	1.00301
29	33.37	1285838.7	998720.0	1.00845	.98972	1.00312
30	33.94	1307728.3	1015721.9	1.00837	.98937	1.00323
31	34.50	1329255.4	1032442.1	1.00831	.98903	1.00334
32	35.05	1350437.2	1048894.2	1.00824	.98868	1.00345
33	35.60	1371289.9	1065090.6	1.00818	.98834	1.00356
34	36.13	1391828.3	1081043.0	1.00812	.98800	1.00367
35	36.66	1412066.3	1096761.9	1.00806	.98766	1.00378
36	37.18	1432016.6	1112257.4	1.00800	.98732	1.00389
37	37.69	1451691.1	1127538.8	1.00795	.98698	1.00400
38	38.20	1471101.0	1142614.5	1.00790	.98664	1.00411
39	38.70	1490256.6	1157492.8	1.00785	.98630	1.00422
40	39.19	1509167.6	1172181.2	1.00780	.98596	1.00433
41	39.68	1527843.3	1186686.8	1.00775	.98562	1.00444
42	40.16	1546292.2	1201016.1	1.00770	.98528	1.00455
43	40.63	1564522.3	1215175.5	1.00766	.98495	1.00466
44	41.10	1582541.2	1229170.9	1.00761	.98461	1.00477
45	41.57	1600356.1	1243007.9	1.00757	.98427	1.00488
46	42.03	1617973.7	1256691.7	1.00753	.98394	1.00499
47	42.48	1635400.5	1270227.2	1.00749	.98360	1.00510
48	42.93	1652642.6	1283619.2	1.00745	.98327	1.00521
49	43.38	1669705.6	1296872.2	1.00741	.98294	1.00532
50	43.82	1686595.1	1309990.4	1.00737	.98261	1.00543

Fig. 3a. (continued)

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
51	44.25	1703316.2	1322977.8	1.00734	.98227	1.00555
52	44.69	1719873.9	1335838.2	1.00730	.98194	1.00566
53	45.11	1736272.8	1348575.4	1.00727	.98161	1.00577
54	45.54	1752517.4	1361192.7	1.00723	.98128	1.00588
55	45.96	1768612.0	1373693.5	1.00720	.98095	1.00599
56	46.37	1784560.8	1386081.0	1.00717	.98062	1.00611
57	46.78	1800367.5	1398358.2	1.00714	.98029	1.00622
58	47.19	1816035.8	1410527.9	1.00711	.97997	1.00633
59	47.60	1831569.5	1422593.0	1.00708	.97964	1.00644
60	48.00	1846971.8	1434556.1	1.00705	.97931	1.00655
61	48.40	1862246.1	1446419.8	1.00702	.97899	1.00667
62	48.79	1877395.5	1458186.4	1.00699	.97866	1.00678
63	49.19	1892422.9	1469858.3	1.00696	.97834	1.00689
64	49.57	1907331.4	1481437.8	1.00693	.97801	1.00700
65	49.96	1922123.6	1492927.0	1.00691	.97769	1.00712
66	50.34	1936802.3	1504328.1	1.00688	.97736	1.00723
67	50.72	1951370.0	1515642.9	1.00686	.97704	1.00734
68	51.10	1965829.2	1526873.5	1.00683	.97672	1.00746
69	51.47	1980182.3	1538021.6	1.00681	.97640	1.00757
70	51.85	1994431.6	1549089.2	1.00678	.97608	1.00768
71	52.21	2008579.3	1560077.8	1.00676	.97576	1.00780
72	52.58	2022627.5	1570989.1	1.00673	.97544	1.00791
73	52.95	2036578.4	1581824.9	1.00671	.97512	1.00802
74	53.31	2050433.8	1592586.5	1.00669	.97480	1.00814
75	53.67	2064195.8	1603275.5	1.00667	.97448	1.00825
76	54.02	2077866.2	1613893.4	1.00664	.97416	1.00837
77	54.38	2091446.8	1624441.6	1.00662	.97385	1.00848
78	54.73	2104939.4	1634921.3	1.00660	.97353	1.00859
79	55.08	2118345.6	1645334.0	1.00658	.97321	1.00871
80	55.43	2131667.1	1655680.9	1.00656	.97290	1.00882
81	55.77	2144905.4	1665963.2	1.00654	.97258	1.00894
82	56.11	2158062.1	1676182.2	1.00652	.97227	1.00905
83	56.46	2171138.8	1686338.9	1.00650	.97196	1.00917
84	56.79	2184136.7	1696434.5	1.00648	.97164	1.00928
85	57.13	2197057.4	1706470.1	1.00646	.97133	1.00939
86	57.47	2209902.2	1716446.7	1.00644	.97102	1.00951
87	57.80	2222672.4	1726365.4	1.00642	.97071	1.00962
88	58.13	2235369.3	1736227.2	1.00641	.97040	1.00974
89	58.46	2247994.1	1746033.0	1.00639	.97009	1.00985
90	58.79	2260548.1	1755783.8	1.00637	.96978	1.00997
91	59.11	2273032.5	1765480.5	1.00635	.96947	1.01008
92	59.44	2285448.3	1775123.9	1.00634	.96916	1.01020
93	59.76	2297796.7	1784715.0	1.00632	.96885	1.01032
94	60.08	2310078.8	1794254.6	1.00630	.96854	1.01043
95	60.40	2322295.7	1803743.5	1.00628	.96823	1.01055
96	60.72	2334448.3	1813182.6	1.00627	.96793	1.01066
97	61.03	2346537.7	1822572.5	1.00625	.96762	1.01078
98	61.34	2358564.8	1831914.0	1.00624	.96732	1.01089
99	61.66	2370530.6	1841208.0	1.00622	.96701	1.01101
100	61.97	2382436.1	1850455.0	1.00620	.96671	1.01113

Fig. 3a. (continued)

EXAMPLE-GAS FLOW (FPV OPTION)
PIPE ID = 6.019 INCHES
ORIF. ID = 4.675 INCHES

FLOWING PRESS = 24.00 PSIG
FLOWING TEMP = 128.0DEG F
RANGE = 100.0 INCHES

PER CENT FULL SCALE	M PPH	M SCFH
1	2.049	40.226
2	2.889	56.723
3	3.533	69.371
4	4.076	80.030
5	4.554	89.420
6	4.987	97.969
7	5.384	105.716
8	5.754	112.984
9	6.102	119.810
10	6.431	126.268
11	6.744	132.412
12	7.043	138.283
13	7.330	143.915
14	7.606	149.336
15	7.872	154.568
16	8.130	159.629
17	8.380	164.536
18	8.623	169.301
19	8.859	173.937
20	9.089	178.454
21	9.313	182.860
22	9.533	187.164
23	9.747	191.373
24	9.957	195.491
25	10.162	199.527
26	10.364	203.483
27	10.561	207.365
28	10.756	211.177
29	10.946	214.922
30	11.134	218.605
31	11.318	222.228
32	11.500	225.794
33	11.679	229.305
34	11.855	232.765
35	12.029	236.175
36	12.200	239.538
37	12.369	242.856
38	12.536	246.130
39	12.700	249.362
40	12.863	252.554
41	13.024	255.708
42	13.182	258.824
43	13.339	261.904
44	13.494	264.950
45	13.648	267.962
46	13.800	270.942
47	13.950	273.890
48	14.098	276.809
49	14.245	279.696
50	14.391	282.558
51	14.535	285.391
52	14.678	288.197
53	14.820	290.977
54	14.960	293.732
55	15.099	296.463
56	15.237	299.170
57	15.374	301.853
58	15.509	304.514
59	15.644	307.153
60	15.777	309.771
61	15.909	312.367
62	16.041	314.944
63	16.171	317.500
64	16.300	320.037
65	16.428	322.555
66	16.556	325.055
67	16.682	327.537
68	16.807	330.001
69	16.932	332.448
70	17.056	334.878
71	17.179	337.291
72	17.301	339.688
73	17.422	342.070
74	17.543	344.436
75	17.662	346.787
76	17.781	349.123
77	17.900	351.444
78	18.017	353.752
79	18.134	356.045
80	18.250	358.325
81	18.365	360.591
82	18.480	362.844
83	18.594	365.084
84	18.708	367.311
85	18.821	369.526
86	18.933	371.729
87	19.044	373.920
88	19.155	376.098
89	19.266	378.266
90	19.375	380.421
91	19.485	382.566
92	19.593	384.700
93	19.702	386.822
94	19.809	388.935
95	19.916	391.036
96	20.023	393.128
97	20.129	395.209
98	20.234	397.280
99	20.339	399.341
100	20.444	401.393

Fig. 3a. (continued)

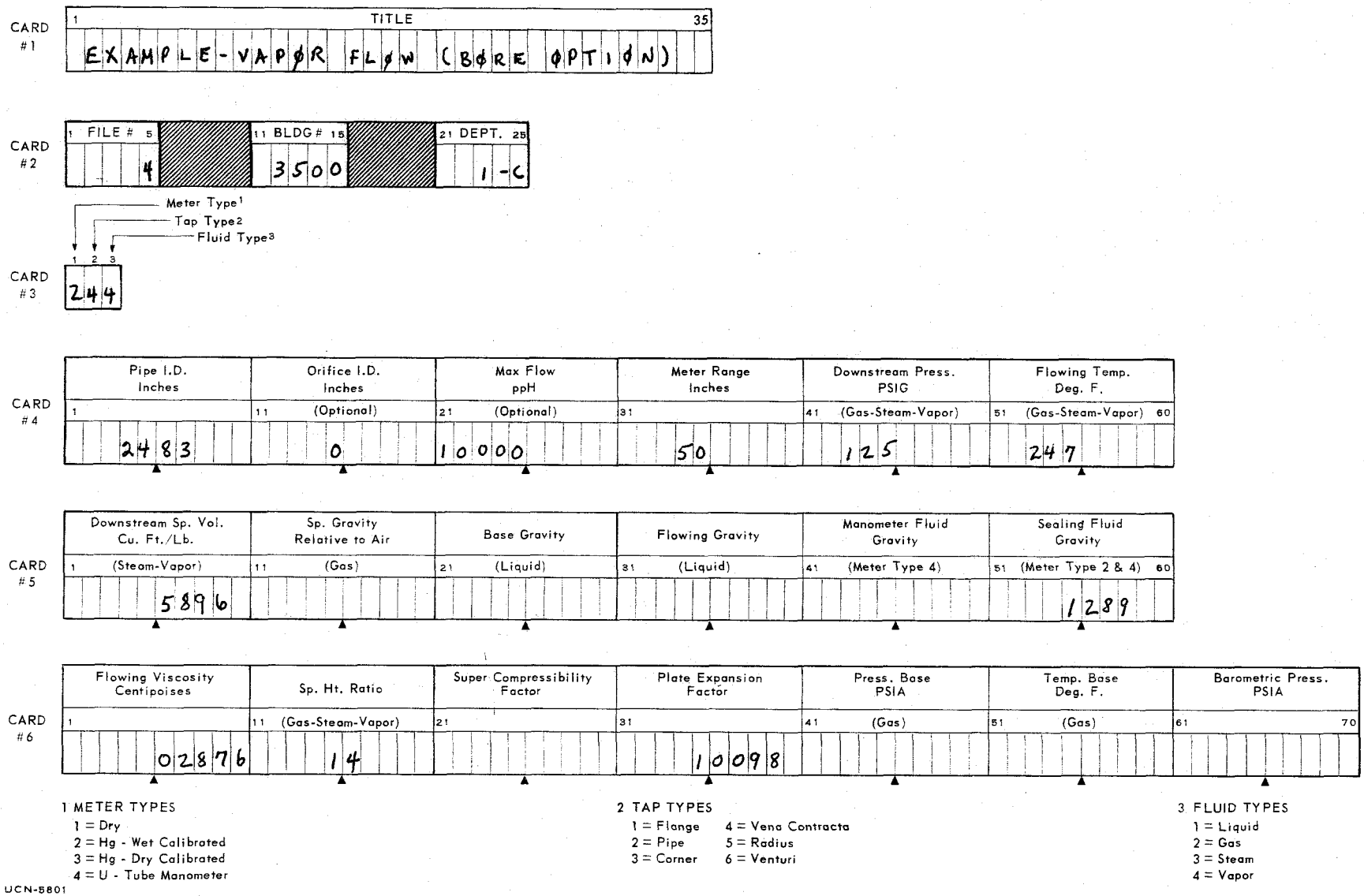


Fig. 4. Flow Calculation Input Data for Vapor Flow (Bore Option).

FILE NO. 4

FLOW CALCULATION

EXAMPLE-VAPOR FLOW (BORE OPTION) METER = 2
BLDG. NO. 3500 TAPS = 4
DEPT. NO. I-C FLUID = 4

PIPE ID =	2.4830	INCHES
ORIFICE ID =	1.9931	INCHES
BETA =	.8027	DIAMETER RATIO
METER RANGE =	50.0	INCHES
VISCOSITY =	.0288	CENTIPOISES (FLOWING)
ORIFICE REY. NO. =	771150	MIDSCALE
GM =	13.5707	MANOMETER FLUID GRAVITY
GS =	1.2890	SEALING FLUID GRAVITY
FLOWING PRESS =	125.0	PSIG (DOWNSTREAM)
FLOWING TEMP =	247.0	DEG. F
K =	1.400	SPECIFIC HEAT RATIO
V2 =	.590	CUBIC FEET / LB. (DOWNSTREAM)

FB =	1054.03094	
FR =	1.00942	MIDSCALE
FA =	1.00980	
FM =	.95132	
FS =	.1171528	
Y2 =	1.00061	MIDSCALE
C =	119.81296	

METER READING INCHES	DIFF PRESS INCHES H20	PPH
5.0	4.53	3175.24
10.0	9.05	4481.18
15.0	13.58	5482.81
20.0	18.10	6327.15
25.0	22.63	7071.07
30.0	27.15	7743.71
35.0	31.68	8362.38
40.0	36.20	8938.35
45.0	40.73	9479.43
50.0	45.25	9991.34

METER 1 = DRY
2 = HG, DRY CAL.
3 = HG, WET CAL.
4 = U-TUBE MAN.

TAPS 1 = FLANGE
2 = PIPE
3 = CORNER
4 = VENA CONTRACTA
5 = RADIUS
6 = VENTURI

FLUID 1 = LIQUID
2 = GAS
3 = STEAM
4 = VAPOR

Fig. 4a. Flow Calculation Output Data for Vapor Flow (Bore Option).

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
1	8.35	110724.5	88879.9	1.02485	.99995	1.00001
2	11.80	155990.1	125215.2	1.02094	.99991	1.00002
3	14.46	190673.8	153056.3	1.01894	.99986	1.00004
4	16.69	219889.7	176508.2	1.01763	.99981	1.00005
5	18.66	245614.9	197158.2	1.01668	.99977	1.00006
6	20.44	268862.4	215819.3	1.01595	.99972	1.00007
7	22.08	290233.5	232974.2	1.01535	.99967	1.00008
8	23.61	310119.8	248937.1	1.01485	.99963	1.00010
9	25.04	328793.1	263926.4	1.01442	.99958	1.00011
10	26.39	346451.1	278100.7	1.01405	.99954	1.00012
11	27.68	363243.3	291580.0	1.01372	.99949	1.00013
12	28.91	379285.5	304457.3	1.01343	.99944	1.00015
13	30.09	394669.9	316806.6	1.01316	.99940	1.00016
14	31.23	409471.2	328687.8	1.01292	.99935	1.00017
15	32.33	423751.1	340150.4	1.01270	.99930	1.00018
16	33.39	437560.9	351235.8	1.01250	.99926	1.00019
17	34.41	450944.2	361978.7	1.01231	.99921	1.00021
18	35.41	463938.2	372409.1	1.01214	.99916	1.00022
19	36.38	476574.9	382552.7	1.01198	.99912	1.00023
20	37.33	488882.2	392432.0	1.01183	.99907	1.00024
21	38.25	500884.6	402066.5	1.01168	.99903	1.00025
22	39.15	512603.7	411473.5	1.01155	.99898	1.00027
23	40.03	524058.5	420668.5	1.01142	.99893	1.00028
24	40.89	535266.3	429665.1	1.01130	.99889	1.00029
25	41.73	546242.2	438475.6	1.01119	.99884	1.00030
26	42.56	557000.1	447111.1	1.01108	.99879	1.00032
27	43.37	567552.5	455581.6	1.01098	.99875	1.00033
28	44.16	577910.7	463896.3	1.01088	.99870	1.00034
29	44.95	588085.0	472063.3	1.01078	.99866	1.00035
30	45.71	598084.9	480090.4	1.01069	.99861	1.00036
31	46.47	607919.0	487984.4	1.01061	.99856	1.00038
32	47.21	617595.4	495751.7	1.01052	.99852	1.00039
33	47.95	627121.3	503398.3	1.01044	.99847	1.00040
34	48.67	636503.5	510929.5	1.01036	.99842	1.00041
35	49.38	645746.5	518350.5	1.01029	.99838	1.00043
36	50.08	654861.9	525666.0	1.01022	.99833	1.00044
37	50.77	663849.3	532880.3	1.01015	.99829	1.00045
38	51.45	672715.7	539997.5	1.01008	.99824	1.00046
39	52.12	681466.0	547021.4	1.01002	.99819	1.00047
40	52.79	690104.4	553955.6	1.00995	.99815	1.00049
41	53.44	698635.3	560803.5	1.00989	.99810	1.00050
42	54.09	707062.5	567568.1	1.00983	.99806	1.00051
43	54.73	715389.8	574252.5	1.00978	.99801	1.00052
44	55.36	723620.5	580859.4	1.00972	.99796	1.00054
45	55.99	731758.0	587391.5	1.00967	.99792	1.00055
46	56.61	739805.3	593851.2	1.00961	.99787	1.00056
47	57.22	747765.4	600240.8	1.00956	.99783	1.00057
48	57.83	755641.1	606562.8	1.00951	.99778	1.00058
49	58.42	763435.0	612819.0	1.00946	.99773	1.00060
50	59.02	771149.5	619011.6	1.00942	.99769	1.00061

Fig. 4a. (continued)

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
51	59.60	778787.1	625142.4	1.00937	.99764	1.00062
52	60.19	786350.0	631213.2	1.00932	.99760	1.00063
53	60.76	793840.4	637225.8	1.00928	.99755	1.00065
54	61.33	801260.3	643181.9	1.00924	.99750	1.00066
55	61.90	808611.6	649082.9	1.00920	.99746	1.00067
56	62.46	815896.2	654930.3	1.00915	.99741	1.00068
57	63.01	823116.0	660725.7	1.00911	.99737	1.00069
58	63.56	830272.5	666470.3	1.00907	.99732	1.00071
59	64.11	837367.5	672165.6	1.00904	.99727	1.00072
60	64.65	844402.4	677812.6	1.00900	.99723	1.00073
61	65.19	851378.9	683412.7	1.00896	.99718	1.00074
62	65.72	858298.2	688966.9	1.00893	.99714	1.00076
63	66.25	865161.9	694476.5	1.00889	.99709	1.00077
64	66.77	871971.1	699942.4	1.00886	.99705	1.00078
65	67.29	878727.3	705365.6	1.00882	.99700	1.00079
66	67.81	885431.6	710747.2	1.00879	.99695	1.00080
67	68.32	892085.1	716088.1	1.00875	.99691	1.00082
68	68.83	898689.1	721389.2	1.00872	.99686	1.00083
69	69.33	905244.6	726651.4	1.00869	.99682	1.00084
70	69.83	911752.7	731875.5	1.00866	.99677	1.00085
71	70.33	918214.3	737062.3	1.00863	.99673	1.00087
72	70.82	924630.5	742212.7	1.00860	.99668	1.00088
73	71.31	931002.2	747327.3	1.00857	.99663	1.00089
74	71.80	937330.3	752407.0	1.00854	.99659	1.00090
75	72.28	943615.7	757452.4	1.00851	.99654	1.00091
76	72.76	949859.2	762464.1	1.00848	.99650	1.00093
77	73.24	956061.8	767443.0	1.00846	.99645	1.00094
78	73.71	962224.0	772389.5	1.00843	.99641	1.00095
79	74.18	968346.9	777304.4	1.00840	.99636	1.00096
80	74.65	974431.0	782188.2	1.00838	.99631	1.00098
81	75.12	980477.1	787041.5	1.00835	.99627	1.00099
82	75.58	986486.0	791864.9	1.00833	.99622	1.00100
83	76.04	992458.2	796658.9	1.00830	.99618	1.00101
84	76.50	998394.5	801424.0	1.00828	.99613	1.00102
85	76.95	1004295.5	806160.8	1.00825	.99609	1.00104
86	77.40	1010161.8	810869.8	1.00823	.99604	1.00105
87	77.85	1015994.0	815551.4	1.00820	.99599	1.00106
88	78.30	1021792.8	820206.1	1.00818	.99595	1.00107
89	78.74	1027558.6	824834.4	1.00816	.99590	1.00109
90	79.18	1033292.0	829436.7	1.00813	.99586	1.00110
91	79.62	1038993.6	834013.5	1.00811	.99581	1.00111
92	80.06	1044663.9	838565.1	1.00809	.99577	1.00112
93	80.49	1050303.5	843092.0	1.00807	.99572	1.00114
94	80.92	1055912.7	847594.6	1.00805	.99568	1.00115
95	81.35	1061492.1	852073.2	1.00803	.99563	1.00116
96	81.78	1067042.1	856528.3	1.00800	.99558	1.00117
97	82.20	1072563.3	860960.2	1.00798	.99554	1.00118
98	82.62	1078056.0	865369.3	1.00796	.99549	1.00120
99	83.05	1083520.7	869755.9	1.00794	.99545	1.00121
100	83.46	1088957.8	874120.4	1.00792	.99540	1.00122

Fig. 4a. (continued)

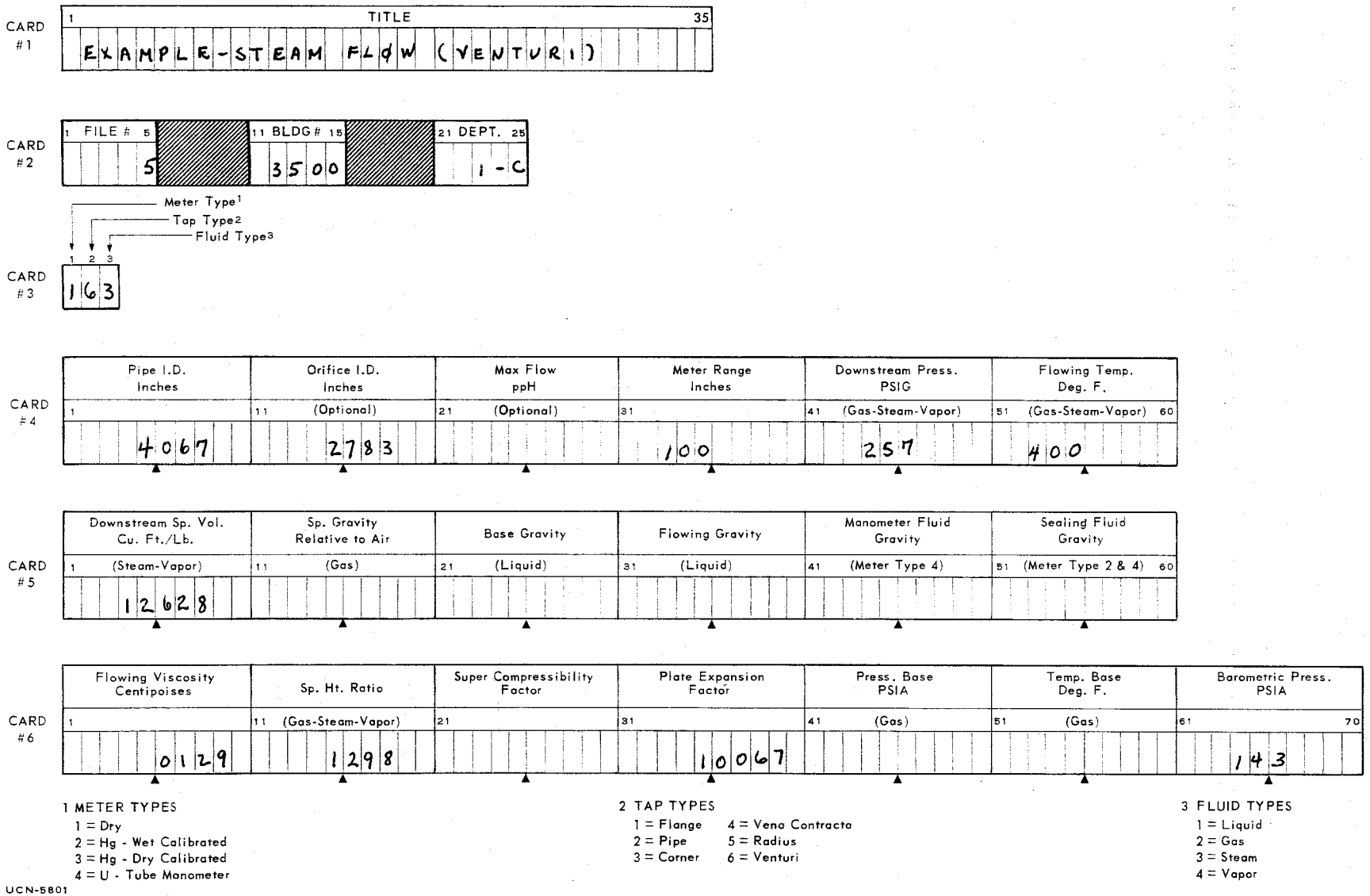
EXAMPLE-VAPOR FLOW (BORE OPTION)
PIPE ID = 2.483 INCHES
ORIF. ID = 1.993 INCHES

FLOWING PRESS = 125.00 PSIG
FLOWING TEMP = 247.0DEG F
RANGE = 50.0 INCHES

PER CENT FULL SCALE	M PPH
1	1.015
2	1.430
3	1.747
4	2.015
5	2.251
6	2.464
7	2.660
8	2.842
9	3.013
10	3.175
11	3.329
12	3.476
13	3.617
14	3.753
15	3.884
16	4.011
17	4.133
18	4.252
19	4.368
20	4.481
21	4.591
22	4.699
23	4.804
24	4.907
25	5.007
26	5.106
27	5.203
28	5.298
29	5.391
30	5.483
31	5.573
32	5.662
33	5.749
34	5.835
35	5.920
36	6.004
37	6.086
38	6.168
39	6.248
40	6.327
41	6.405
42	6.483
43	6.559
44	6.635
45	6.709
46	6.783
47	6.856
48	6.929
49	7.000
50	7.071

PER CENT FULL SCALE	M PPH
51	7.141
52	7.211
53	7.279
54	7.348
55	7.415
56	7.482
57	7.548
58	7.614
59	7.679
60	7.744
61	7.808
62	7.871
63	7.934
64	7.997
65	8.059
66	8.121
67	8.182
68	8.242
69	8.303
70	8.362
71	8.422
72	8.481
73	8.539
74	8.597
75	8.655
76	8.713
77	8.770
78	8.826
79	8.882
80	8.938
81	8.994
82	9.049
83	9.104
84	9.159
85	9.213
86	9.267
87	9.320
88	9.374
89	9.427
90	9.479
91	9.532
92	9.584
93	9.636
94	9.687
95	9.739
96	9.790
97	9.841
98	9.891
99	9.941
100	9.991

Fig. 4a. (continued)



1 METER TYPES
1 = Dry
2 = Hg - Wet Calibrated
3 = Hg - Dry Calibrated
4 = U - Tube Manometer

2 TAP TYPES
1 = Flange
2 = Pipe
3 = Corner
4 = Vena Contracta
5 = Radius
6 = Venturi

3 FLUID TYPES
1 = Liquid
2 = Gas
3 = Steam
4 = Vapor

UCN-5801
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Fig. 5. Flow Calculation Input Data for Steam Flow (Venturi).

FILE NO. 5

FLOW CALCULATION

EXAMPLE-STEAM FLOW (VENTURI)
BLDG. NO. 3500
DEPT. NO. I-C

METER = 1
TAPS = 6
FLUID = 3

PIPE ID	=	4.0670 INCHES
ORIFICE ID	=	2.7830 INCHES
BETA	=	.6843 DIAMETER RATIO
METER RANGE	=	100.0 INCHES
VISCOSITY	=	.0129 CENTIPOISES (FLOWING)
ORIFICE REY. NO.	=	1084274MIDSCALE
FLOWING PRESS	=	25.7 PSIG (DOWNSTREAM)
FLOWING TEMP	=	400.0 DEG. F
K	=	1.298 SPECIFIC HEAT RATIO
V2	=	12.628 CUBIC FEET / LB. (DOWNSTREAM)
FB	=	2916.77490
FR	=	1.00000 MIDSCALE
FA	=	1.00670
FM	=	1.00000
FS	=	.0472439
Y2	=	.92636 MIDSCALE
C	=	128.50783

METER READING INCHES	DIFF PRESS INCHES H20	PPH
10.0	10.00	2577.29
20.0	20.00	3642.30
30.0	30.00	4457.79
40.0	40.00	5143.85
50.0	50.00	5747.04
60.0	60.00	6291.26
70.0	70.00	6790.70
80.0	80.00	7254.63
90.0	90.00	7689.49
100.0	100.00	8099.98

METER 1 = DRY
2 = HG, DRY CAL.
3 = HG, WET CAL.
4 = U-TUBE MAN.

TAPS 1 = FLANGE
2 = PIPE
3 = CORNER
4 = VENA CONTRACTA
5 = RADIUS
6 = VENTURI

FLUID 1 = LIQUID
2 = GAS
3 = STEAM
4 = VAPOR

Fig. 5a. Flow Calculation Output Data for Steam Flow (Venturi).

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
1	6.32	153339.5	104928.4	1.00000	.92910	.92952
2	8.94	216854.8	146391.2	1.00000	.92862	.92946
3	10.95	265591.8	181741.3	1.00000	.92813	.92939
4	12.65	306679.0	209856.8	1.00000	.92765	.92932
5	14.14	342877.6	234627.1	1.00000	.92717	.92926
6	15.49	375603.6	257021.1	1.00000	.92669	.92919
7	16.73	405698.2	277614.5	1.00000	.92621	.92913
8	17.89	433709.6	296782.4	1.00000	.92573	.92906
9	18.97	460018.5	314785.3	1.00000	.92525	.92900
10	20.00	484902.1	331812.8	1.00000	.92477	.92893
11	20.98	508569.6	348008.2	1.00000	.92429	.92887
12	21.91	531183.7	363482.7	1.00000	.92382	.92880
13	22.80	552873.5	378324.8	1.00000	.92334	.92874
14	23.66	573743.9	392606.2	1.00000	.92286	.92868
15	24.49	593881.4	406386.0	1.00000	.92239	.92861
16	25.30	613358.1	419713.7	1.00000	.92191	.92855
17	26.08	632235.0	432630.9	1.00000	.92144	.92848
18	26.83	650564.5	445173.6	1.00000	.92097	.92842
19	27.57	668391.5	457372.4	1.00000	.92049	.92835
20	28.28	685755.2	469254.1	1.00000	.92002	.92829
21	28.98	702689.9	480842.4	1.00000	.91955	.92822
22	29.66	719226.1	492157.9	1.00000	.91908	.92816
23	30.33	735390.5	503219.0	1.00000	.91861	.92809
24	30.98	751207.1	514042.2	1.00000	.91814	.92803
25	31.62	766697.6	524642.1	1.00000	.91767	.92796
26	32.25	781881.2	535032.0	1.00000	.91720	.92790
27	32.86	796775.5	545224.0	1.00000	.91673	.92784
28	33.47	811396.4	555229.0	1.00000	.91627	.92777
29	34.06	825758.6	565056.8	1.00000	.91580	.92771
30	34.64	839875.1	574716.6	1.00000	.91533	.92764
31	35.21	853758.3	584216.7	1.00000	.91487	.92758
32	35.78	867419.3	593564.8	1.00000	.91440	.92751
33	36.33	880868.5	602767.9	1.00000	.91394	.92745
34	36.88	894115.3	611832.6	1.00000	.91348	.92739
35	37.42	907168.8	620764.9	1.00000	.91301	.92732
36	37.95	920037.1	629570.5	1.00000	.91255	.92726
37	38.47	932727.9	638254.6	1.00000	.91209	.92719
38	38.99	945248.3	646822.2	1.00000	.91163	.92713
39	39.50	957605.0	655277.8	1.00000	.91117	.92706
40	40.00	969804.2	663625.6	1.00000	.91071	.92700
41	40.50	981852.0	671869.7	1.00000	.91025	.92694
42	40.99	993753.6	680013.9	1.00000	.90979	.92687
43	41.47	1005514.4	688061.6	1.00000	.90933	.92681
44	41.95	1017139.3	696016.4	1.00000	.90887	.92675
45	42.43	1028632.7	703881.2	1.00000	.90842	.92668
46	42.90	1039999.2	711659.1	1.00000	.90796	.92662
47	43.36	1051242.8	719353.0	1.00000	.90751	.92655
48	43.82	1062367.3	726965.4	1.00000	.90705	.92649
49	44.27	1073376.6	734498.9	1.00000	.90660	.92643
50	44.72	1084274.1	741956.0	1.00000	.90614	.92636

Fig. 5a. (continued)

PCT FULL SCALE	EXTEN.	ORIF.REY.NO.	PIPE REY.NO.	FR	Y1	Y2
51	45.17	1095063.2	749338.8	1.00000	.90569	.92630
52	45.61	1105747.0	756649.6	1.00000	.90524	.92624
53	46.04	1116328.5	763890.4	1.00000	.90479	.92617
54	46.48	1126810.7	771063.2	1.00000	.90433	.92611
55	46.90	1137196.3	778170.0	1.00000	.90388	.92605
56	47.33	1147487.9	785212.4	1.00000	.90343	.92598
57	47.75	1157688.0	792192.2	1.00000	.90298	.92592
58	48.17	1167799.0	799111.0	1.00000	.90253	.92585
59	48.58	1177823.2	805970.5	1.00000	.90209	.92579
60	48.99	1187762.8	812772.0	1.00000	.90164	.92573
61	49.40	1197619.9	819517.1	1.00000	.90119	.92566
62	49.80	1207396.6	826207.2	1.00000	.90074	.92560
63	50.20	1217094.7	832843.5	1.00000	.90030	.92554
64	50.60	1226716.1	839427.3	1.00000	.89985	.92548
65	50.99	1236262.7	845959.9	1.00000	.89941	.92541
66	51.38	1245736.1	852442.5	1.00000	.89896	.92535
67	51.77	1255138.0	858876.1	1.00000	.89852	.92529
68	52.15	1264470.0	865261.9	1.00000	.89807	.92522
69	52.54	1273733.7	871600.9	1.00000	.89763	.92516
70	52.92	1282930.4	877894.1	1.00000	.89719	.92510
71	53.29	1292061.7	884142.6	1.00000	.89675	.92503
72	53.67	1301128.9	890347.1	1.00000	.89631	.92497
73	54.04	1310133.4	896508.8	1.00000	.89587	.92491
74	54.41	1319076.4	902628.4	1.00000	.89543	.92484
75	54.77	1327959.2	908706.7	1.00000	.89499	.92478
76	55.14	1336782.9	914744.7	1.00000	.89455	.92472
77	55.50	1345548.8	920743.1	1.00000	.89411	.92466
78	55.86	1354257.9	926702.7	1.00000	.89367	.92459
79	56.21	1362911.4	932624.2	1.00000	.89324	.92453
80	56.57	1371510.3	938508.3	1.00000	.89280	.92447
81	56.92	1380055.6	944355.8	1.00000	.89236	.92441
82	57.27	1388548.4	950167.2	1.00000	.89193	.92434
83	57.62	1396989.5	955943.4	1.00000	.89149	.92428
84	57.97	1405379.9	961684.8	1.00000	.89106	.92422
85	58.31	1413720.5	967392.2	1.00000	.89062	.92415
86	58.65	1422012.2	973066.1	1.00000	.89019	.92409
87	58.99	1430255.8	978707.1	1.00000	.88976	.92403
88	59.33	1438452.2	984315.8	1.00000	.88933	.92397
89	59.67	1446602.1	989892.7	1.00000	.88889	.92391
90	60.00	1454706.4	995438.4	1.00000	.88846	.92384
91	60.33	1462765.8	1000953.3	1.00000	.88803	.92378
92	60.66	1470781.0	1006438.0	1.00000	.88760	.92372
93	60.99	1478752.7	1011893.0	1.00000	.88717	.92366
94	61.32	1486681.8	1017318.7	1.00000	.88674	.92359
95	61.64	1494568.7	1022715.7	1.00000	.88632	.92353
96	61.97	1502414.3	1028084.3	1.00000	.88589	.92347
97	62.29	1510219.1	1033425.1	1.00000	.88546	.92341
98	62.61	1517983.8	1038738.3	1.00000	.88503	.92334
99	62.93	1525708.9	1044024.6	1.00000	.88461	.92328
100	63.25	1533395.2	1049284.2	1.00000	.88418	.92322

Fig. 5a. (continued)

EXAMPLE-STEAM FLOW (VENTURI)
PIPE ID = 4.067 INCHES
ORIF. ID = 2.783 INCHES

FLOWING PRESS = 25.70 PSIG
FLOWING TEMP = 400.0DEG F
RANGE = 100.0 INCHES

PER CENT FULL SCALE	M PPH
1	.816
2	1.153
3	1.412
4	1.631
5	1.823
6	1.997
7	2.157
8	2.306
9	2.445
10	2.577
11	2.703
12	2.823
13	2.938
14	3.049
15	3.155
16	3.259
17	3.359
18	3.456
19	3.550
20	3.642
21	3.732
22	3.820
23	3.905
24	3.989
25	4.071
26	4.151
27	4.230
28	4.307
29	4.383
30	4.458
31	4.531
32	4.603
33	4.674
34	4.744
35	4.813
36	4.881
37	4.948
38	5.014
39	5.079
40	5.144
41	5.207
42	5.270
43	5.332
44	5.393
45	5.454
46	5.514
47	5.573
48	5.632
49	5.690
50	5.747

PER CENT FULL SCALE	M PPH
51	5.804
52	5.860
53	5.916
54	5.971
55	6.025
56	6.080
57	6.133
58	6.186
59	6.239
60	6.291
61	6.343
62	6.394
63	6.445
64	6.496
65	6.546
66	6.596
67	6.645
68	6.694
69	6.742
70	6.791
71	6.839
72	6.886
73	6.933
74	6.980
75	7.027
76	7.073
77	7.119
78	7.164
79	7.210
80	7.255
81	7.299
82	7.344
83	7.388
84	7.432
85	7.475
86	7.519
87	7.562
88	7.605
89	7.647
90	7.689
91	7.732
92	7.773
93	7.815
94	7.856
95	7.898
96	7.938
97	7.979
98	8.020
99	8.060
100	8.100

Fig. 5a. (continued)

ORNL-TM-1093

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