Consumer and Corporate Affairs
Standards

Consommation et corporations
Normes

SPG-237

OTTAWA, Ontario

May 13, 1977

Your file *Votre référence*

Our file *Notre référence*

G6635-E172

SPECIAL APPROVAL

Granted to: Liquid Carbonic Canada Limited,
15 Industrial Drive, Box 1877,
Regina, Saskatchewan
S4O 3E1

Attention: Mr. Nels Holm,
Plant Superintendent.

Subject: Eastech Incorporated,
Model 2220-422-11X
Vortex Shedding Flow Transmitter.

Special Approval has been granted by the Legal Metrology and Laboratory Services Branch to Liquid Carbonic Canada Limited for the installation of a measuring system incorporating one Eastech Incorporated vortex shedding flow meter and auxiliary attachments for measurement of oxygen gas.

Location: Liquid Carbonic Canada Limited,
Albert Street North,
Regina, Saskatchewan.

Details of the meter and auxiliary attachments are as follows:

1. Eastech Flow Transmitter

Model Number:	2220-422-11X
Size:	4 inch, schedule 40 bore
Maximum Working Pressure:	1650 psig
Material:	Stainless steel - 316
Flow Range:	1500 to 25,000 ACFH
"K" Factor (Meter Factor):	30 Pulses per ACF

2. Auxiliary Attachments

a. Eastech Flow Computer
Manufactured by:
Waugh Controls Corporation
Chatsworth, California, U.S.A.

Eastech Model Number:	4302-4-10101
Serial Number:	3925
Ambient Operating Temperature Range:	40°F to 120°F
Programmed Pressure Range:	150 psig to 250 psig
Base Pressure:	14.7 psia
Programmed to Atmospheric Pressure:	14.7 psia
Programmed Temperature Range:	50°F to 150°F
Base Temperature:	60°F
Supercompressibility Factor:	1*
Program Factor:	0.1521

* The supercompressibility factor for oxygen of 1.0035 may be used at the discretion of the user. This factor is the average value for the system's operating ranges of temperature and pressure.

b. Pressure Transducer
Manufactured by:
The Foxboro Company Limited

Model number	E11GM-1SA-G
Serial number:	3037914
Pressure range:	150 psig to 250 psig
Analog output:	4ma = 150 psig 20ma = 250 psig

c. Temperature Transducer
Manufactured by:
The Foxboro Company Limited

Eastech Model number	6401
Serial number:	1161
Temperature range:	50°F to 150°F

Thermal Well, for above temperature transducer-
Manufactured by:
The Foxboro Company Limited

Eastech Model number:	6402

The following flow system components require government sealing.

a. Computer

The computer is to be sealed in such a manner as to prevent access to its adjustments via the front and rear panels. Also, operations of the reset button on the counter is to be prevented by drilling a hole throught the button so that a sealing wire or an approved equivalent, passing through the hole will prevent resetting the counter.

b. Flow Meter

The access cover on the electronic pickup is to be sealed to the enclosure. Also, since the sensor can be interchanged between meter bodies of the same size but the interchangeability is not approved, the sensor must be sealed to the meter body so as to retain both components as one integral unit.

c. Pressure Transducer and Temperature Transducer

It is required that the access covers be sealed to the bodies of the transducers.

Installation Requirements

The flow meter is to be installed with the electronic pick-up at the uppermost vertical location.

The maximum allowable length of the interconnecting cables from the flow meter, the pressure transducer, and the temperature transducer to the computer is 100 feet. Transmission cables are to be enclosed in conduits carrying only cables for one particular measurement system. Where transmission cables are run inside control cabinets, etc., the shielded cables shall be bundled and separated from other conductors. Also, conduits carrying transmission cables shall not closely parallel conduits carrying power to electrical motors, starters, etc.

Since the type of system can be affected by electrical noise, the installation procedures with regard to use of shielded cables and sound principles of electrical interconnection of components, such as proper grounding, etc., must be followed.

The flow meter must be placed in service by following the upstream and downstream piping requirements as described in the manufacturer's bulleting #DS-2200-2300 1/75 (copy attached).

For field test procedure refer to the attached Appendix 'A'.

D.L. Smith,
Chief,
Electricity & Gas Division.

c.c. Mr. Ken Guenther, Neptune/Eastech, Inc.
Mr. J. Duff, D.I. (E&G) Regina, Sask.

APPENDIX "A"

Ref: Special Approval SPG-237 13-5-77

FIELD TEST PROCEDURE

1. Set up the test system as illustrated in the attached schematic diagram. Reference should be made to the installation requirements specified in the approval notice and the manual provided by the manufacturer.

2. It is recommended that the measuring system be pre-checked and adjusted, if necessary, by Eastech representatives before verification testing is commenced.

   The program factor keyed into the computer should be checked and recorded.

3. Using the transfer prover in manual mode and with the pressure transducer and temperature sensor set up with the appropriate sources and standards, simulate meter conditions at the following parameter values:

   (a) Press Trans: minimum approved pressure + 20% of span, where span = difference between minimum and maximum approved values.

   Temp. Trans: bulb temperature of 60°F.

   Meter: test at 10% and 100% of max. meter capacity -- if the high load cannot be reached because of limitations of the test equipment, then the highest achievable rate shall be used. Allow sufficient passage of volume through the system to produce a minimum resolution of ± 0.25% of the computer's S.C.F. readout.

   Note: Refer to the data sheet attached for a guide to the tabulation of test data and computation of system error.

   (b) Press Trans: minimum approved pressure + 80% of span.

   Temp. Trans: bulb temperature of 60°F.

   Meter: same test as indicated in (a).

...2

(c) Press Trans: minimum approved pressure + 80% of span.

Temp. Trans: bulb temperature of 32°F.

Meter: same tests as indicated in (a).

(d) Press Trans: minimum approved pressure + 20% of span.

Temp. Trans: bulb temperature of 32°F.

Meter: same tests as indicated in (a).

METHOD OF CALCULATION

1. Determine the true volume, at test conditions, V_L, through the test meter by using the volume indicated on the transfer prover console, V_p, and applying correction factors for:

   (a) transfer prover metering error, C_M,

   (b) pressure difference between the standard meter and the test meter, C_p, and

   (c) the temperature difference between the two meters, C_T.

   This can be represented by:

   $$V_L = V_p \times C_M \times C_T \times C_p.$$

2. The correct volume, at base conditions, V_B, can then be calculated, from the simulated line conditions, by:

   $$V_B = V_L \times \frac{520}{460 + T_{TT}} \times \frac{Pa + P_{PT}}{14.73}$$ where:

   V_B = true volume at base conditions.

   V_L = true volume at test conditions (refer to 1 above).

   T_{TT} = temperature at sensor of tenperature transducer

   P_{PT} = pressure at pressure transducer

   P_a = programmed average atmospheric pressure

...3

3. The true volume at base conditions, V_B, is then compared to the volume readout from the computer, V_C, and the percent error evaluated using:

$$\frac{V_C - V_B}{V_B} \times 100$$

Allowable error is ± 2.5%

4. The attached data sheet can be used for data tabulation and as a calculation guide.

Note: If a supercompressibility factor is incorporated into the computer, it should be used as a multiplier for V_B before determining the metering error.

This factor should be the same as the one programmed into the computer, i.e. 1.0035, as described in the Special Approval.

EASTECH

The VS-21 Flow Transmitters Series 2200 and 2300

The Series 2200 and 2300 vortex shedding flow transmitters utilize the patented* VS-21 series flow element to generate output pulse signals at frequencies linear with volumetric flowrate over wide turn-down ratios.

The 2200 Series, recommended particularly for slurries, liquids and gases containing significant amounts of suspended solids, features a removable flow element with a pair of thermal sensors mounted in its front face.

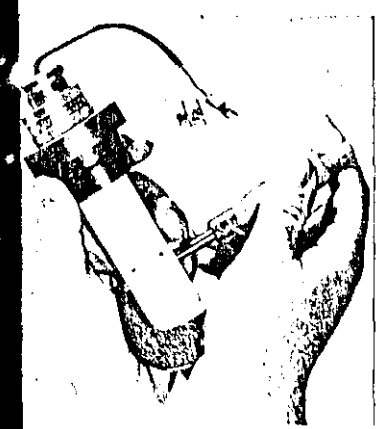
The 2300 Series, suitable for gases and liquids, has a removable flow element and a single, centrally located, thermal sensor which may be removed and replaced without disturbing the flow element.

A close-coupled solid state preamplifier is provided to increase the signal amplitude prior to transmission to a flow converter which may be remotely located up to 2,500 feet.

The flow transmitter may be used to indicate, totalize, batch and control flow in either digital or analog systems when employed with a flow converter or auxiliary equipment.

Optionally, the 2200-2300 Series can be supplied as part of an intrinsically safe system with FM approval for Class I, Div I, Groups B, C & D

- No moving parts—the signals are generated by the flow itself
- Measure gases, liquids or slurries
- Low pressure loss
- Cannot be damaged by overranging
- Wide turndown up to 100:1
- Same calibration factor for all meters of a given size
- Easily removable and interchangeable flow elements
- Fixed calibration factor—based on dimensions of flow element

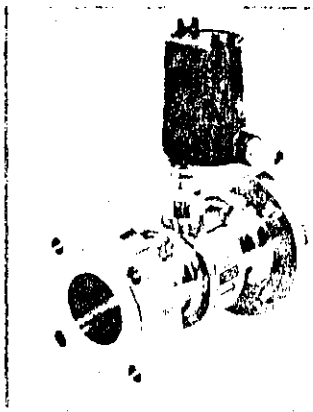


Series 2200

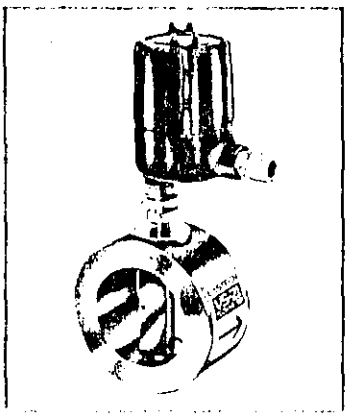
Series 2300

Above Left: Verifying calibration by dimensional check of flow element
Above Right: Flow element with central sensor showing ease of removal for examination and/or replacement

*U.S. Patents 3,472,117 and 3,587,312, others pending



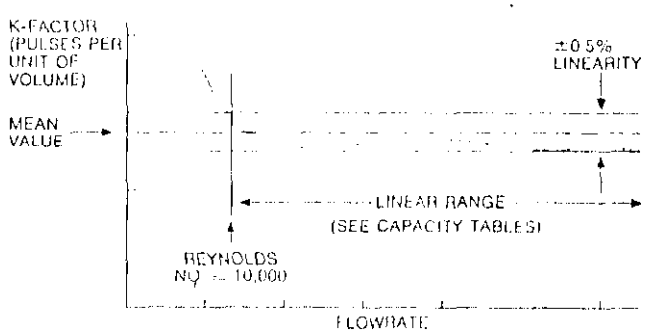
Models 2210 and 2310, flange style



Models 2220 and 2320, wafer style

- Intrinsically safe
  FM approved for Class I, Div. I, Groups B, C & D
- Same calibration factor for all liquids and gases, independent of fluid properties
- Materials and end connections to suit a wide variety of applications
- Interchangeable, solid state preamplifier module

Repeatability	±0.1% of reading or better
Linearity	±0.5% of reading at pipe Reynolds numbers of 10,000 and above
Calibration accuracy	±0.25% derived from NBS traceable water calibration of master meter in each size
Pressure Loss	6 psi with water at 20 ft./sec. 5 inches WC with atmospheric air at 100 ft./sec.
Response time	5 milliseconds at 100 Hz signal frequency
Minimum measurable flow	Corresponding to pipe Reynolds number of 5,000
Turn down ratio	Up to 100:1



TYPICAL CALIBRATION CURVE

1/2, 2, 3, 4 and 6 inch line sizes. Internal diameter equivalent to schedule 40 pipe. Larger and smaller sizes available in other models.

Optional: Internal diameters to suit other schedule piping

odels 2210 and 2310 . . . . . 150, 300 and 600 lb. ANSI RF flanges

odels 2220 and 2320 . . . . . Fit between 150, 300 and 600 lb. ANSI RF flanges (with alignment rings). 900 and 1,500 lb. ANSI female face flanges

ptional: Higher flange ratings. Victaulic, sanitary, tubing and hreaded end connections

ter body (2220, 2320) . . . 316 SS

ter body (2210, 2310) . . . 304 SS

inges (2210, 2310) . . . . . Carbon steel or 304 SS

ow element . . . . . 316 SS

nsors (2200 Series) . . . . . Borosilicate glass coated sensors on metal rims, stainless steel or Hastelloy C, mounted and sealed with impermeable alumina base epoxy.

nsor (2300 Series) . . . . . Borosilicate glass encapsulated sensor in 316 SS or Hastelloy C tubing mounted and sealed in flow element with compatible Swagelok* tube fittings.

rings on flow element . . . . Buna N, Viton** or Neoprene

ptional: Other materials for meter body and flow element. ow element welded into meter body for high pressure, high low temperature or sanitary service.

essure . . . . . Dictated by mating flanges. 3,600 psi maximum.

uid temperature . . . . . Models 2210 and 2220:
-65 to +300°F for epoxy sealed sensors.
Models 2310 and 2320:
-65 to +250°F (Buna N O-rings)
-20 to +400°F (Viton O-rings)
-65 to +300°F (Neoprene O-rings)
-320 to 400°F (Welded-in flow element)

uid temperature span . . . . . Any 100°F span within above ranges

ousing . . . . . Aluminum alloy, weatherproof construction

Connections . . . . . 2 or 3 wires to flow element sensor
3 wires and shield to flow converter through 1/2-inch NPT connection on housing

Electrical rating . . . . . Explosion proof (class 1, divisions 1 and 2, groups C and D; class 2, divisions 1 and 2, groups E, F and G).

Intrinsically-safe version available with FM approval

Input power . . . . . 24 or 36 VDC from flow converter

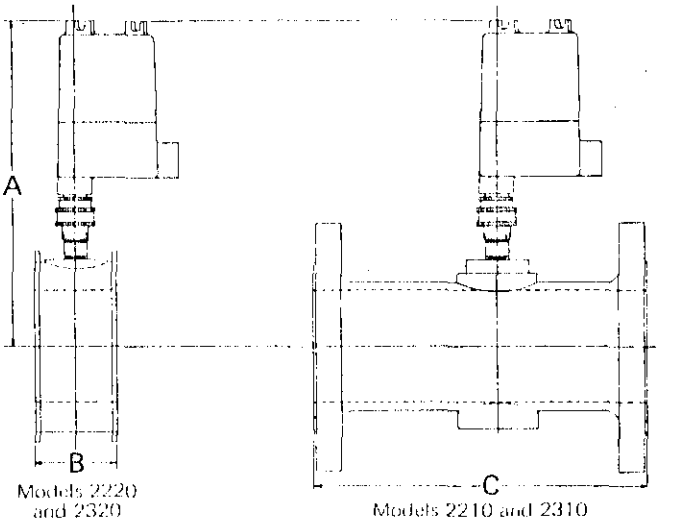
Output signal . . . . . Sine wave-type waveform 1 to 3 volts peak to peak riding on a 4 to 22 VDC bias.

Frequency range . . . . . Model A — Up to 250 Hz
Model B — Up to 400 Hz

Components . . . . . Solid state. Silicon transistors and integrated circuits.

Operating temperature . . . . . -40 to +180°F

Optional: When measuring fluids at higher or lower temperatures, preamplifier may be isolated from the meter body.



DIMENSIONS
Inches (Millimeters)

Meter Size (Inches)	A	B	C	Weight—lbs. 2210* and 2310	Weight—lbs. 2220 and 2320
1-1/2	10.4 (264)	2 (50.8)	9 (228)	12	6
2	10.7 (272)	2 (50.8)	9 (228)	18	7
3	11.1 (282)	2.5 (63.5)	10 (254)	35	10
4	11.8 (297)	3 (76.2)	12 (305)	50	17
6	12.7 (322)	4.25 (108)	14 (356)	86	34

*150 lb. RF flanges

Crawford Fitting Company **Trademark of E. I. Du Pont de Nemours Company, Inc.
Consult factory for CSA pressure rating

Meter Size (Inches)	LINEAR RANGE[1] GPM (BPH)		Nominal Calibration Factor[4] Pulses/Gallon	
	Minimum[2]	Maximum[3]	Series 2200	Series 2300
*1-1/2	5.5 (8)	190 (271)	64	128
2	7.5 (11)	315 (450)	29	58
3	11 (16)	600 (986)	9	18
4	15 (21)	1190 (1700)	4	8
6	22 (31)	2700 (3860)	1.2	2.4

*Turn down limited to:
a. Model 2210 & 2220 any 3:1 ratio up to 140 GPM
b. Model 2310 & 2320 any 10:1 ratio up to 120 GPM. Any 5:1 ratio above 120 GPM

Meter Size (Inches)	LINEAR RANGE[1] SCFM, (MMSCFD)		Nominal Calibration Factor[4] Pulses/Actual Cubic Foot	
	Minimum[5]	Maximum[6]	Series 2200	Series 2300
*1-1/2	10 (.014)	33 (.048)	479	957
2	13 (.019)	72 (.104)	217	434
3	19 (.027)	230 (.33)	67	134
4	25 (.036)	510 (.74)	30	60
6	38 (.055)	1200 (1.7)	9	18

*Turn down limited to:
a. Model 2210 & 2220 any 3:1 ratio up to 260 HZ
b. Model 2310 & 2320 any 10:1 ratio up to 600 HZ

Operating range depends on the filter used in the flow converter. Standard ranges; any 10 to 1 or 100 to 1 within the listed maximum and minimum flowrates. The non-linear range extends down to a flowrate one-half the minimum listed value.

For liquids with 1 centistoke viscosity, such as water at 60°F. To determine the minimum flowrate for any other viscosity, multiply the listed value by the viscosity in centistokes. See TD-1.

Corresponding to velocities of 30 feet per second in schedule 40 pipe. Higher flowrates can be measured.

Resolution can be increased in the flow converter.

For gases such as natural gas, air, oxygen, nitrogen and others of similar viscosity. With the exception of hydrogen, helium and neon, all other common gases have lower minimum flowrates than those listed.

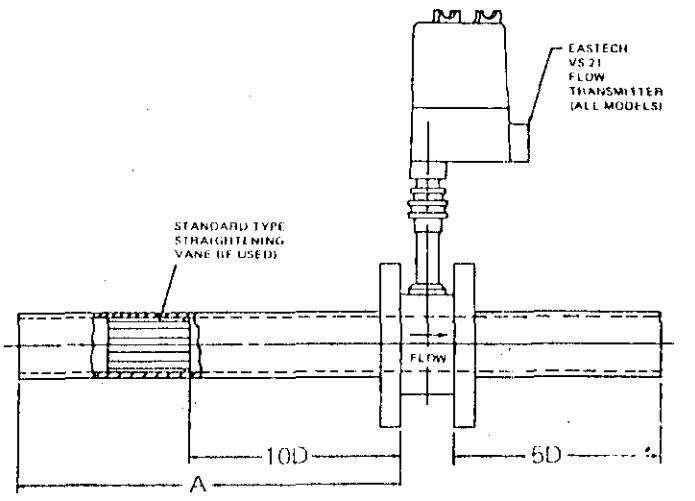
Typical values. Higher flowrates can be measured. Based on 60°F and 14.7 psia, maximum capacities increase directly with increasing absolute pressure and decreasing absolute temperature according to the gas law.

To insure that the VS-21 flow transmitter performs to its full capability, it is ***necessary*** to provide a straight, unobstructed run of upstream and downstream piping. The values listed in the accompanying table are absolute minimums for the conditions stated. Fifty percent longer upstream runs are recommended whenever circumstances permit. When there are several fittings or unusual obstructions ahead of the transmitter, refer to Eastech for guidance. Use of an adequate amount of straight pipe ensures that the velocity profile entering the transmitter is uniform and free of distortions.

Gaskets upstream and at the transmitter should not protrude into the flow. The internal bore of the adjacent piping should be the same as that of the transmitter (Schedule 40 standard) for ten diameters upstream plus five diameters downstream (from transmitter center). It should also be smooth and free of protruding weld beads. The transmitter bore should be aligned with that of the adjacent piping. Alignment rings are provided for this purpose for wafer body models.

If required, a pressure tap should be located within four pipe diameters upstream of the transmitter, and a temperature tap should be close downstream but not less than two pipe diameters.

A convenient way to follow these recommendations is by use of a metering tube to AGA/ASME orifice meter standards (using lengths indicated in the table). This approach is particularly advised for all sales or custody transfer situations.



Upstream Fitting or Obstruction	Recommended Dimension A	
	Without Vanes	With Vanes
90° Elbow	20 D	15 D
Two 90° Elbows Same Plane	25 D	15 D
Two 90° Elbows Different Planes	40 D	15 D
Reduction in Pipe Diameter	20 D	15 D
Expansion in Pipe Diameter	40 D	20 D
Valve Partially Closed or Regulator	Recommend Meter Upstream	

2210- 311- 111- 1

2210 Face Sensor, Flanged
2220 Face Sensor, Wafer
2310 Central Sensor, Flanged
2320 Central Sensor, Wafer
X Other[1]

1.5 1½ inch
2 2 inch
3 3 inch
4 4 inch
6 6 inch
X Other[1]

1 150 lb.
2 300 lb.
3 600 lb.
4 900 lb.
X Other[1]

1 316 Stainless Steel
2 304 Stainless Steel
3 Carbon Steel
4 304 Stainless Steel and Carbon Steel Flanges
X Other[1]

1 Standard
X Other[1]

1 316 Stainless Steel
3 Carbon Steel
X Other[1]

1 Buna N
2 Viton
3 Neoprene
8 Ethylene propylene (EPR)
5 Welded flow element
X Other[1]

0 None
1 Explosion proof
2 Intrinsically safe[2]
X Other[1]

Note 1: Not FM approved
Note 2: FM approved for Class I, Div. I, Groups B, C & D

n ordering, provide the following information:
el number
id description
rate range *
perature range *
sure range *
cific Gravity
osity
ional features
ormal, minimum, maximum)

nformation on other meters and auxiliary equipment, to the appropriate specification sheet.

Converters, Indicators, Totalizers and Computers

el 4100 (wall mount) DS-4100
el 4200 (panel mount) DS-4200
el 4300 Flow Computer (panel mount) DS-4300

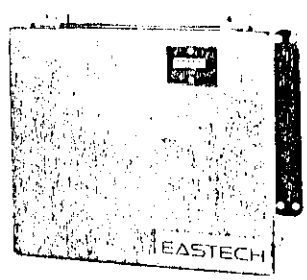
Transmitters (pipeline)

l 2400 (shuttle sensor) DS-2400
el 2500 (8 through 36 inch) ..... DS 2500

rtion Flow Transmitters

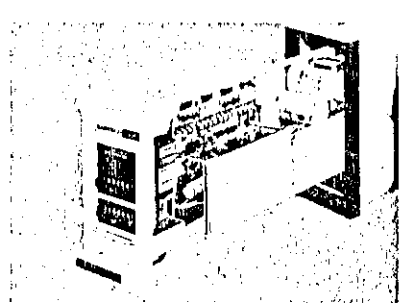
l 2610 (fixed) ..... DS 2600
2620 (low pressure, hot tap, adjustable) DS-2600
el 2630 (high pressure, hot tap, adjustable) DS-2630
2640 (low pressure, adjustable) DS-2600

tal Flowrate Indicator DS-4410
Oscillator DS-4500
ering Tubes DS-6800



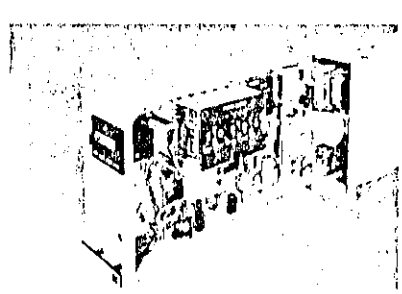
Model 4100 Series Flow Computer is designed for stationary or over the-road applications. Optional features include scaling to engineering units, totalizers predetermining counters, analog rate indicators, analog outputs, and relay closure outputs. Weatherproof and explosion-proof housings are available.

Model 4101 FM approved as Non Incendive for Class I, Div. 2, Groups B, C & D.



Model 4200 Series Flow Computer is similar in function to the Model 4100 except for providing panel mounting.

Model 4201 FM approved as Non-Incendive for Class I, Div. 2, Groups B, C & D.



Model 4300 Series Digital Flow Computer provides a totalized readout in volume units corrected to standard conditions or in mass units. The base unit provides temperature and pressure or density compensation utilizing a wide range of standard transducers. Options include predetermining counters, analog rate indicators, analog outputs and relay closure outputs.

neptune / EASTECH
308 TALMADGE ROAD, EDISON, N.J. 08817
PHONE (201) 287-1111 • TELEX 844-586

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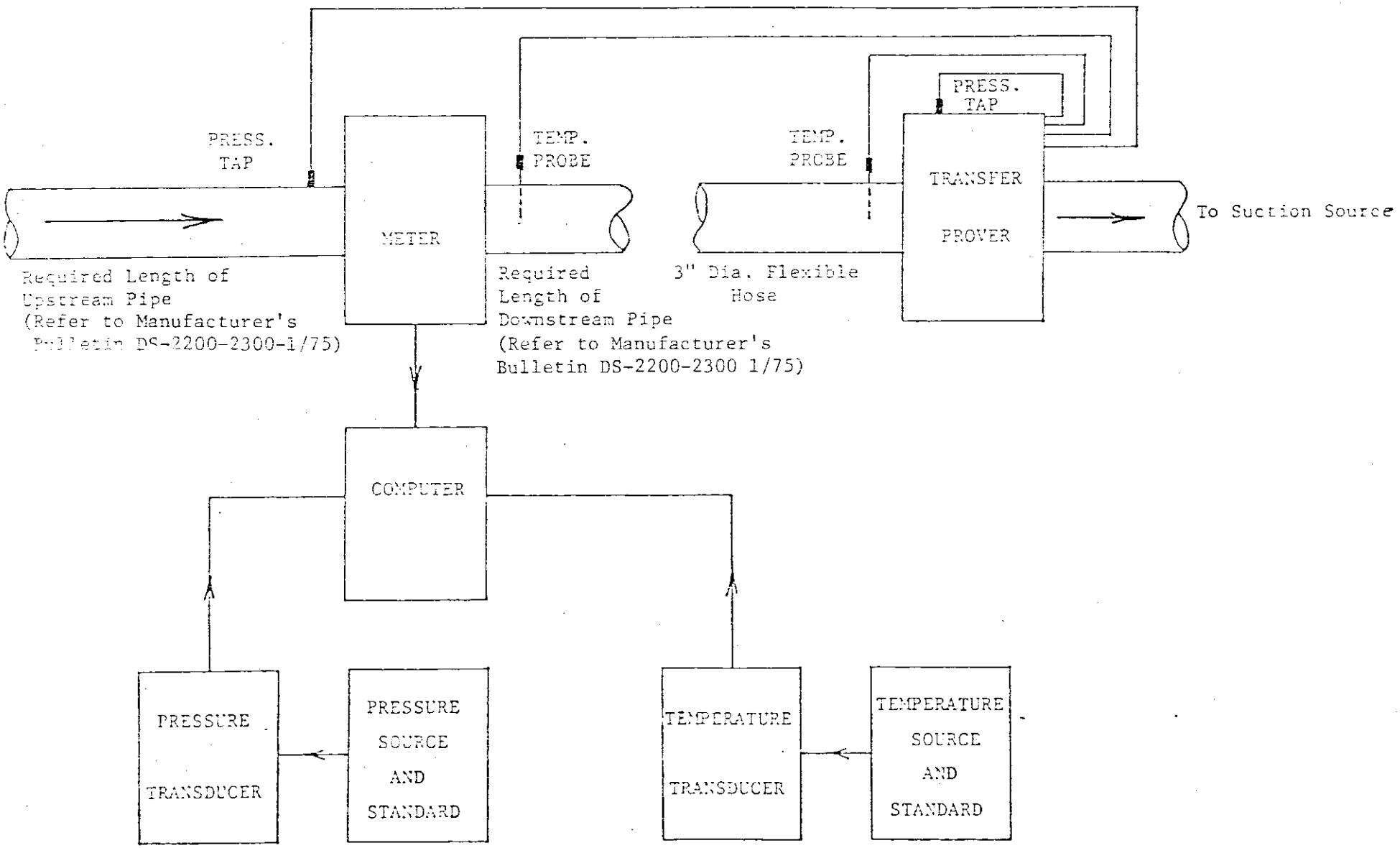
SCHEMATIC DIAGRAM - APPARATUS SETUP FOR TESTING EASTECH MEASURING SYSTEM



District Office: Inspection No. System Location Date

Transfer Prover No. Meter S/N: Computer S/N: Press. Transducer S/N: Temp. Transducer S/N:

Computer	Final Reading, cu. ft.								
	Initial Reading, cu. ft.								
	Volume Passed, V_c (cu. ft.)								
Temperature Sensor, T_{TT} (F)									
Pressure Transducer, P_{PT} (psig)									
Programmed Atm. Press., P_a (psia)									
Prover Uncorrected Volume, V_p (cu ft)									
Temp. Correction Factor, C_T									
Press. Correction Factor, C_P									
Meter Correction Factor, C_M									
True Test Meter Volume, V_L (cu ft) $V_L = V_p \times C_p \times C_T \times C_M$									
Supercompressibility Factor, F_{pv}									
True Volume at Base Conditions, V_B (cu ft) $V_B = V_L \times \frac{520}{460 \quad T_{TT}} \times \frac{P_a \quad P_{PT}}{14.73} \times F_{pv}^2$									
% Error $= \frac{V_c - V_B}{V_B} \times 100$									

Remarks:

Inspector