DEPARTMENT OF

TRADE AND COMMERCE
CANADA

S-GA.184

STANDARDS BRANCH

OTTAWA April 8, 1960.

TYPE APPROVAL

COMPUTERS FLOW MEASURING SYSTEM MODEL 257

The apparatus specified and illustrated herein has been duly approved by the Standards Branch under the provisions of the Gas Inspection Act, Chap. 129, R.S. 1952, and may be admitted to verification in Canada.

Apparatus Approved: Flow Measuring System Model 257, manufactured by Computers Incorporated, Houston 6, Texas, U.S.A., and distributed in Canada by Wheatley-Taylor Limited, Edmonton, Alberta.

The Flow Measuring System Model 257 comprises the following pieces of apparatus:-

1. Electronic Computer Model 257, manufactured by Computers Incorporated.
2. Differential Pressure Transducer Type D2T, Swartwout Company.
3. Static Pressure Transducer, Norden Ketay Model E-324-B, OR International Resistance Company Pressure Transmitters, Model 30707-10.
4. Flowing Temperature Transducer, Computers Incorporated OR West Instrument Corporation resistance thermometer.

Rating of Apparatus:

Differential Pressure Transducer -

Differential Ranges ..... 0-20 and 0-1000 inches water gauge
Working Pressure ..... up to 5,000 p.s.i.

Static Pressure Transducer -

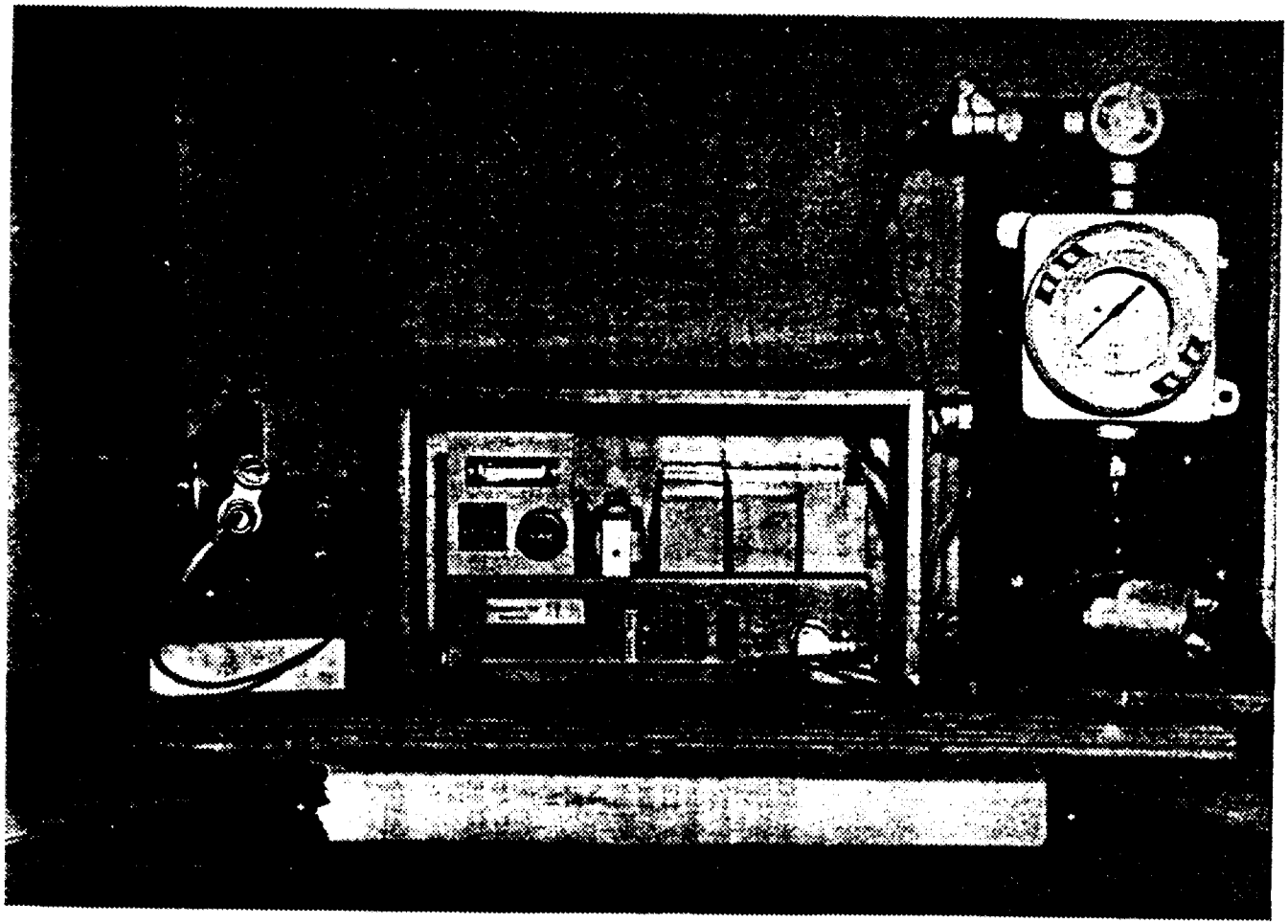
(1) Norden Ketay Model e.g. E-324-B, 0-60 to 0-10,000 p.s.i.
The model is identified by prefix 'E' indicating electrical transmitter, followed by three digits and the suffix letter 'B'. The first digit denotes the metal used for the Bourdon tube - '3' is phosphor bronze, '4' is alloy steel, '6' or '7' is stainless steel, and '9' is K-monel. The second digit is always '2' indicating threaded flangeless ring. The third digit denotes the case design - '3' is wall mounted and '4' is stem mounted. The suffix letter 'B' indicates a stainless steel movement.

(2) International Resistance Company Model 70-2104 .... 0-6 p.s.i.g.
Model 70-2101 .... 0-15 p.s.i.g.
Model 70-2102 .... 0-30 p.s.i.g.
Model 70-2106 .... 0-60 p.s.i.g.
Model 70-2003 .... 0-100 p.s.i.g.
Model 70-2004 .... 0-200 p.s.i.g.

All the above models have a potentiometer resistance of 1000 ohms.

...../2
(Flowing

COMPUTERS FLOW MEASURING SYSTEM MODEL 257



S-GA.184

Flowing Temperature Transducers, -50°F. to +150°F.

(1) Computers Incorporated Model 30707-10 using Charles Ingelhard Inc. resistance thermometer No. 30707-10A, 50.0 ohms resistance at 32°F., or

(2) West Instrument Corporation resistance thermometers, Models AA-0070, AA-0071, AA-0072 with explosion-proof housing, Models AA-0073, AA-0074, AA-0075 with non-explosion-proof housing.
Resistance of all models 120 ohms at 32°F.
Changing from one to the other requires that two resistors be changed in the Computer plug-in adapter unit.

Description: The type D2T differential pressure transducer consists of a diaphragm of stainless steel or teflon-coated glass fabric mechanically coupled to the movable core of a differential transformer, the output of which is connected to the computer.

The static pressure transducer is a potentiometer, the arm being connected to a Bourdon tube so that changes in pressure cause changes in the position of the movable arm. The output is connected to the computer.

The flowing temperature transducer is a resistance thermometer in a housing or probe inserted in the flowing fluid so that changes in temperature are reflected as changes in the resistance of the element, which are fed into the computer.

The computer is designed to receive the outputs from 1) the differential pressure transducer, 2) the static pressure transducer, and 3) the flowing temperature transducer and combine them electronically to solve the flow equation -

$$\text{Flow} = C'' F_{tf} \sqrt{h_w P_f}$$

where F_{tf} is the flowing temperature compensation factor, h_w is the differential pressure across the orifice, P_f is the static pressure in the line. The flow coefficient C" is inserted into the computation by means of a plug-in adapter unit and is the product of the basic orifice factor, Reynolds number factor, expansion factor, pressure base factor, temperature base factor, specific gravity factor and super-compressibility factor. For a single orifice installation, the value of C" is supplied by a standard plug-in adapter unit. A universal adapter unit is available for measurement problems requiring the use of different sizes of orifice plates. With this unit, a computer factor F_c is provided for each particular orifice installation and is obtained from a set of curves. This factor F_c is set on a dial on the front of the computer. The "Flow" solution of the equation is indicated on a small meter on the computer as a percentage of maximum flow, and also appears as an electrical pulse for a pre-selected volume in standard cubic feet, which pulse operates a mechanical counter on the front of the computer to give a visual indication, and a telemetering reading by up to 4 sets of electrical contacts.

Approval is granted for 18 variations of Model 257 Flow Measuring System available for operation from either AC or DC. The varieties of

...../3
(system

system instrumentation are:-

A - Automatic differential pressure compensation
P - Automatic static pressure compensation
M - Manually-adjustable static pressure compensation
T - Automatic flowing temperature compensation
S - Manually-adjustable flowing temperature compensation
U - Manually-adjustable orifice constant.

When a single value of the factor C" has been introduced into the computer, there is no system designation for P_f flowing temperature, T_f or orifice constant.

In addition to the above letters used to define the system instrumentation, other letters are used to indicate:-

D - Systems operated from direct current sources
E - Systems having explosion-proof transducers
EE - Systems having explosion-proof transducers and computer
R - Systems having a manual reset on the accumulated volume counter
C - Systems having auxiliary electrical contacts on the accumulated volume counter, the number of contacts appearing before the letter.

The 18 variations of the Model 257 Flow Measuring System are:-

Model 257 A	Model 257 AP-U
Model 257 A-U	Model 257 APS
Model 257 AM	Model 257 APS-U
Model 257 AM-U	Model 257 AT
Model 257 AS	Model 257 AT-U
Model 257 AS-U	Model 257 ATM
Model 257 AMS	Model 257 ATM-U
Model 257 AMS-U	Model 257 APT
Model 257 AP	Model 257 APT-U

The Flow Computer will not operate unless it is fed with all four factors, viz, differential pressure, static pressure, flowing temperature and flow coefficient C". All components of the Flow Measuring System for a particular installation will be marked with the same serial number.

For testing, a "test switch" is provided which introduces simulated values of 160 p.s.i. static pressure and 20°F. flowing temperature into the computer. These two factors plus the design atmospheric pressure of 13.0 p.s.i. of the computer provide three of the factors in the flow formula. The universal adapter dial is set at a value taken from the graph of the orifice factor.

...../4
(The

The flow equation $Q = C'' F_{tf} \sqrt{h_w (P_s + P_a)}$, when solved for various values of differential pressures h_w, gives the rate of flow and rate of counting, e.g. -- universal adapter dial = 650; C" = 2,260 (from curve); counting rate = 100 cu.ft. per count; static pressure P_s = 160 p.s.i.; atmospheric pressure P_a = 13.0 p.s.i.; flowing temperature T_f = 20°F.; flowing temperature factor F_{tf} = 1.0408; differential pressure h_w = 50"w.g. Rate of flow in cu.ft. per hour from the formula = 218,769 or 60.769 cu.ft. per second.
On the basis of 100 cu.ft. per count, the time required for 100 counts would be 164.55 seconds.

Various values of h_w could be supplied by actual manometer in the above formula and the error found by comparison with the theoretical.

E. F. Power,
Assistant Director (E&G),
Standards Branch.

R. W. MacLean,
Director,
Standards Branch.

Ref: A-751