Consumer and Corporate Affairs Canada
Consumer Standards Directorate

Consommation et Corporations Canada
Direction générale des normes

SPG-246

OTTAWA, June 14, 1978

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G 6635-1

SPECIAL APPROVAL

Granted to: Shell Canada Resources Limited,
Burnt Timber Gas Plant,
Cremona, Alberta.

Attention: Mr. William Evans,
Project Manager.

Subject: 10" XS Non-Standard Orifice Meter Run with Auxiliary Devices.

Special Approval has been granted by the Legal Metrology Branch to Shell Canada Resources Limited for the use of a 10" XS non-standard orifice run at Cremona, Alberta, for the sale of gas to Alberta Gas Trunk Line Co. Ltd. Billing shall be based upon the accumulated flow as indicated on the recorder chart.

Details of the meter and auxiliary attachments for the meter run 10FE-12 are as follows:

1. Orifice Meter:

Manufacturer	Robinson Orifice Fitting Co.
Serial number	77-6131-2
Type	PECO Robinson "E"
Maximum working pressure, psi	1480
Schedule	XS
Flange rating	ASA 600
Nominal pipe size	10"
Inside pipe diameter	9.750"
Orifice diameter	5.625"
Beta (d/D) ratio	0.5769
Pressure taps	Flange
Maximum flow	4,901,460 SCFH

2. Auxiliary Attachments

(a) Chart Recorder:

Manuafacturer	Foxboro Co. Ltd.,
Model	12R
Serial Number	M-305801
Number of pens	3

(i) Temperature: Class 1-A, fully temperature compensated.
Range: 0-100°C.
S.S. capillary length 25 ft. armoured.
Immersion length 6 in.

(ii) Static Pressure: Range: 0-10 MPa
Class: S.S. Helical

(iii) Differential Pressure: Range: 0-50 kPa
Class: 37

(b) Chart:

Manufacturer	Foxboro
Type number	898418
Size	12" Circular
Scale or Chart Range: Temp:	0-100 Lin.
Static press:	0-100 Lin.
Diff. press:	$0\text{-}10\sqrt{h}$

The orifice meter constants shall be calculated in accordance with the AGA Gas Measurement Committee Report No. 3 (1969). However, since the facility is operating utilizing S.I. units, these readings must first be converted to English Units using recognized conversion factors (see CGA SI Conversion Factors for Canadian Gas Industry) for flow rate calculations.

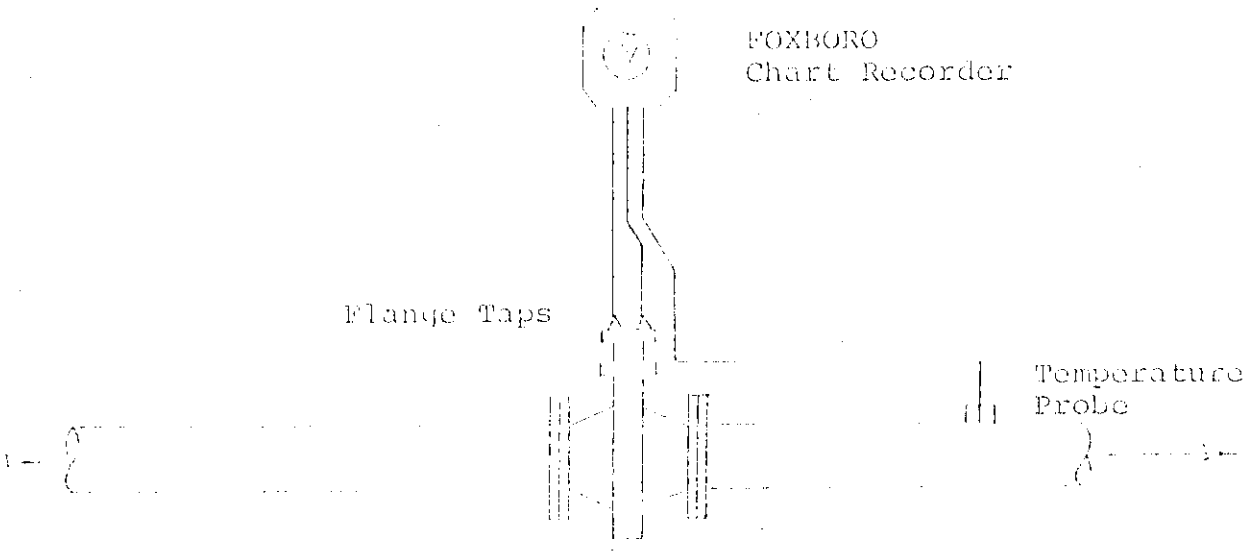
This approval is contingent upon the metering system conforming to the requirements delineated in the applicable Sections of Part VIA and Part II of the Departmental Instructions for the Inspection of Gas Meters and Auxiliary Devices.

A procedure for field testing of this system is outlined in Appendix A attached.

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

c.c. Mr. L. Hewitt, D.I., E&G, Calgary.
Mr. E. M. Bailin, Project Manager, The Ralph M. Parsons Company Limited.
Mr. J. T. Meers, Engineering Department, E.A. Kutryk Industries Limited.

ORIFICE METER INSTALLATION
AT BURNT TIMBER GAS PLANT,
CREMONA, ALBERTA



APPENDIX "A"

Re: Special Approval SPG-246 June 14, 1978

Field Test Procedure for Verification of Shell Canada Resources Limited Orifice Meter Installation at Burnt Timber Gas Plant, Cremona, Alberta.

Field Test Procedure

(A) Primary Elements:

The orifice plate and the installation shall be examined and dimensional measurement made to verify the conformity with Specification No. 7 for Approval of Type of Orifice Gas Meters and their Installation.

(B) Secondary Elements:

During the verification tests it is important for the flow conditions to be stable.

1. For verification tests simulate the flow conditions by applying appropriate temperature, and static and differential pressures, which can be held constant for the duration of the test.

2. Insert the three (3) parameters* obtained above into the following calculated orifice gas equation example, which is based upon the existing Shell Canada Resources system.

EXAMPLE:

CONDITIONS AT METER	VALUE OF FACTOR
Meter equipped with Flange Taps.	
d = diameter of orifice = 5.625 in.	
D = internal dia, of meter tube = 9.750 in.	
Determination of the Basic Orifice Factor, F_b: For the non-standard pipe size with inside diameter of 9.75" the F_b is calculated in accordance to equation (25), section (B12) of Appendix "B", AGA Report #3.	F_b = 6849.14

CONDITIONS AT METER	VALUE OF FACTOR
Static pressure obtained upstream of meter.	
* Average differential (at normal flow), h_w = 132.774 in. W.C.	
* Average static pressure, p_f = 972.7 psia (958 psig)	
Standard atmospheric pressure = 14.7 psia	
β = 5.625 ÷ 9.750 = 0.5769	
$\sqrt{h_w p_f}$ = pressure extension (average) = $(132.774 \times 972.7)^{\frac{1}{2}} = 359.37$	
For β = 0.5769 and D = 9.750; b = 0.0371	
$F_r = 1 + (0.0371 \div 359.37) = 1.001$	$F_r = 1.0001$
Differential ratio, $h_w \div p_f = 132.774 \div 972.7 = 0.1365$	$Y_1 = 0.9983$
p_b = base pressure = 14.7 psia	$F_{pb} = 1.0020$
T_b = temperature base = 60°F	$F_{tb} = 1.000$
*T_f = flowing temperature = 93°F; $\left(F_{tf} = \sqrt{\frac{60+460}{T_f+460}}\right)$	$F_{tf} = 0.9697$
G = specific gravity = 0.61	$F_g = 1.2804$
Supercompressibility factor for 958 psig and 93° F:	$F_{pv} = 1.0645$
Manometer factor:	$F_m = 1.0000$
Area Factor, F_a and Location factor, F_ℓ are assumed to be unity (1.000)	$F_a = 1.0000$ $F = 1.0000$

Orifice constant, C', corresponds to the expression:

$$C' = F_b \times F_r \times Y_1 \times F_{pb} \times F_{tb} \times F_{tf} \times F_g \times F_{pv} \times F_m \times F_a \times F_\ell .$$

Then, C' = 6849.14 x 1.0001x 0.9983 x 1.0020 x 1.0000 x 0.9697 x 1.2804 x 1.0645 x 1.0000 x 1.0000 x 1.0000 = 9056.0

For an average pressure extension, $\sqrt{h_w p_f} = (132.774 \times 972.7)^{\frac{1}{2}} = 359.37$, the flow rate would be

$Q_h = C' \sqrt{h_w p_f} = 9056.0 \times 359.37 = 3,254,455$ cu. ft. per hr.

The above equation, $Q_h = C' \sqrt{h_w p_f}$, can be converted to an equation where all three parameters are included in the solution of the flow equation, namely,

$$Q_h = C'' \sqrt{h_w p_f} \times F_{tf} \qquad \text{.....(1)}$$

where Q_h = rate of flow in cu. ft. per hr. at base conditions,

C' = orifice flow constant as designated in AGA Report No. 3

$$C'' = \frac{C'}{F_{tf}}$$

F_{tf} = gas flowing temperature factor

p_f = absolute static pressure in psia

h_w = differential pressure in inches of water.

Equation (1), above, can be used to calculate the flow at any set of stable operating conditions.

Note: Shell Canada Resources base temperature and pressure is 60°F and 14.7 psia, respectively.

The verification tolerance is in accordance with Departmental Instructions, Part VIA, section 4.