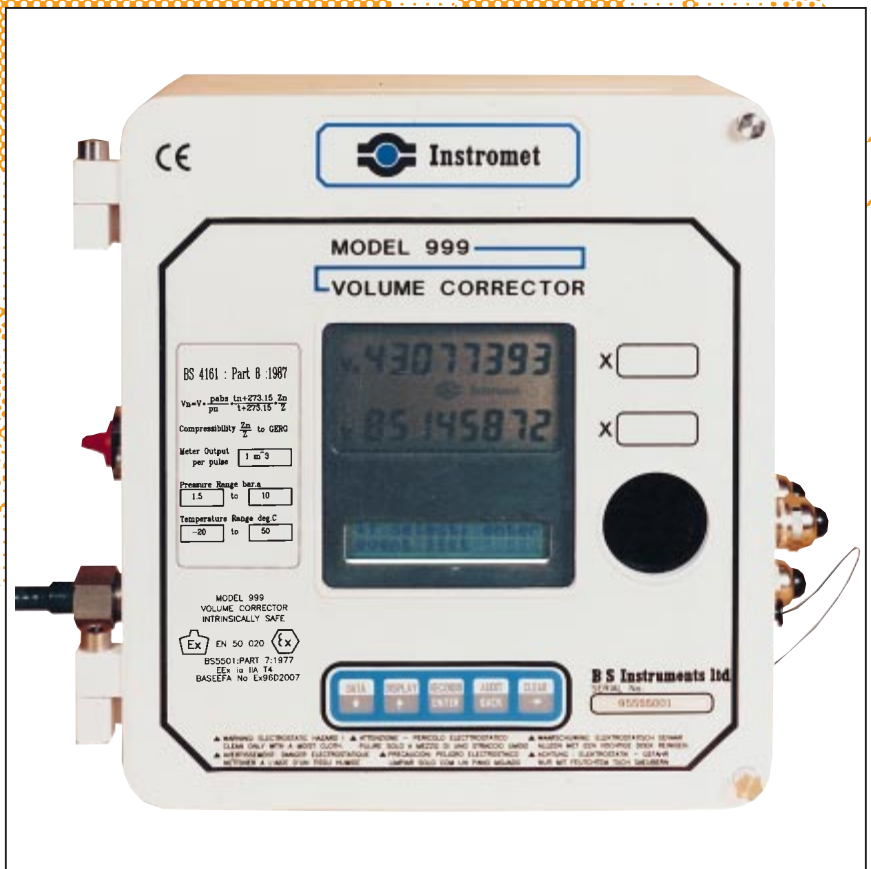


Instromet[®]

ELECTRONIC VOLUME CORRECTOR MODEL 999



INTRODUCTION

The INSTROMET Model 999 Corrector combines a high performance, battery operated volume corrector with a versatile data logger in one compact package. Its primary function is to convert measured line volume accurately to base volume. Its secondary function is to log any of the parameters and data invol-

ved to users requirements. It uses low frequency pulses from the gas-meter and active inputs for pressure and temperature. It also corrects for compressibility taking the influence of gas composition into account. It is designed for pressures up to 80 bar (1200 psi).

OUTSTANDING FEATURES.

Very High Operating Accuracy

To achieve a high operating accuracy over a pressure range of ten to one and an ambient temperature range of -20°C to +60°C the pressure sensor characteristics are stored in the sensor and digital mathematical methods are used to compensate for errors. The maximum error including ambient temperature effects will be $\pm 0.25\%$, but in general the error will be smaller.

Clear Display with Legends for Easy Interpretation

Apart from the display of totalized line and corrected volumes and of alarms, a separate alpha-numeric display can be configured by the user to read other parameters.

Peak-hour and Peak-day data

Peak hourly and peak daily volumes are collected and stored together with date and time.

Vast, flexible Data-logging Facility

This facility can be configured in up to five virtual data loggers with individual timing and logging a number of different parameters each. A memory for up to 32,000 logs is provided.

Windows® based Data Retrieval and Configuration

The vast potential of this Corrector can be fully exploited because of its ease of operation. The Windows® based software provided with the Corrector can be run on any IBM compatible PC and is a familiar environment to communicate with the Corrector. The software features context sensitive "help" and a complete instruction manual.

Easy and efficient maintenance

Audit trail, programmable alarm and error levels for pressure and temperature, easy battery exchange, flexible calibration of transducers, they all contribute to better maintenance and quality control.

Three built-in Serial Ports

An infra-red port, a local serial port and a port for a modem are standard.

Long Battery Life

The replaceable standard D-size Lithium batteries carry sufficient energy for five years normal operation. This time can be extended by adding a second battery.

Dial out facility

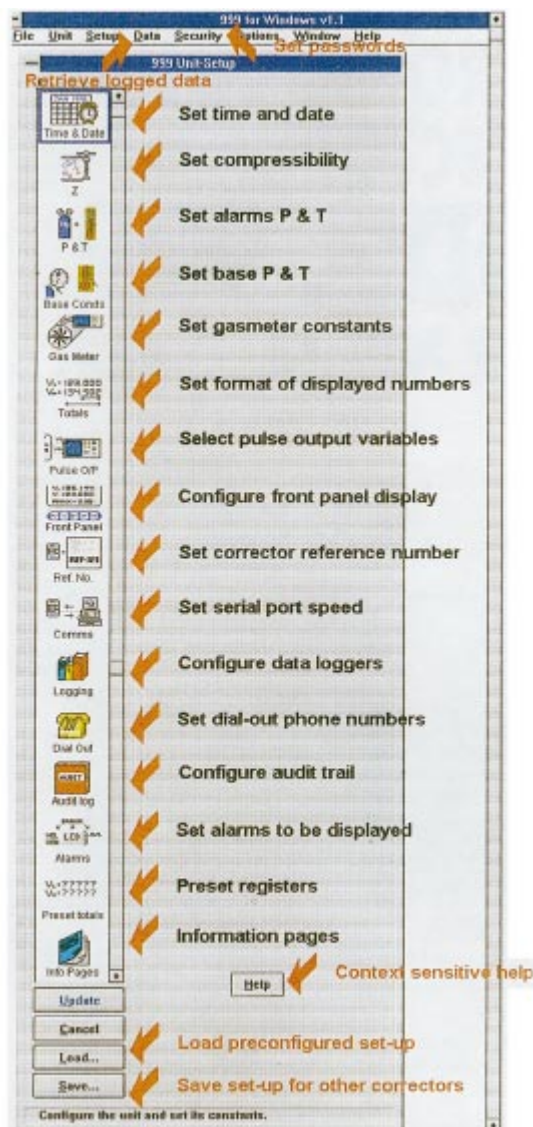
An automatic dial out facility is provided that makes it possible to send out data using a modem. Dial out can occur either at regular intervals or on an alarm. Windows® based software is provided to monitor the dial out facility on an IBM compatible PC. The monitor programme can operate in the background while the PC is used for other duties.

Diagnostics

The Corrector has built-in diagnostics to detect its proper functioning and to detect whether it operates within user defined limits of pressure and temperature.

Wide Range Pressure Sensor

Wide range pressure sensors make it possible to standardise on only one Corrector for a number of pressure levels, thus reducing stock requirements.



DIAL OUT FACILITY

The Corrector can be set to dial out through a modem either on regular hourly, daily, weekly or monthly intervals. The parameters to be sent out can be selected. It is also possible to dial out when an alarm occurs. The specific alarm to initiate dial out can be selected.

These two instances may be programmed simultaneously.

Up to three telephone numbers can be entered. These are entered in order of priority, the next one to be tried if five attempts to dial were not successful. If none of the three numbers can be reached a second trial is made after 2 hours.

AUDIT TRAIL

The Corrector automatically logs any changes in set-up data with the previous and new value and the time and date the change occurred. In addition to these Event Logs, the Corrector automatically logs for all alarms the time and date of their occurrence and clearing and their nature.

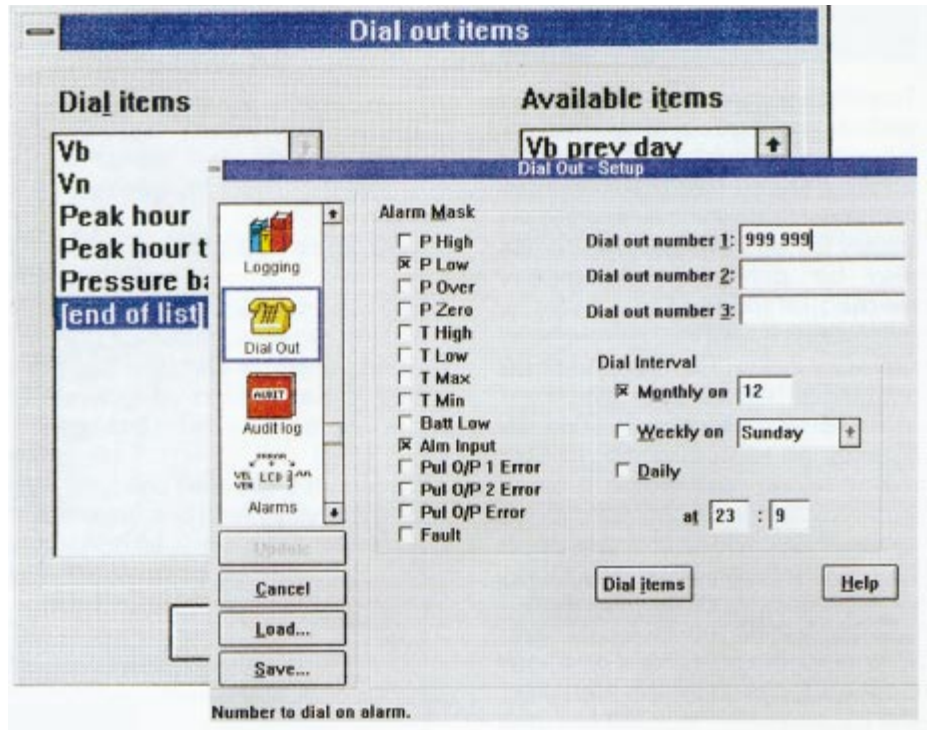
It is also possible for the user to program the Corrector to record, with the above Event and Alarm Logs, additional parameters such as pressure, temperature, flow rate etc. Depending on the number of additional parameters the number of audit logs may vary from 40 to 400.

CALIBRATION

The Corrector will meet its specified accuracy without the need for calibration. However, to fit in with existing inspection and maintenance procedures, a calibration facility is provided.

The pressure and temperature sensors can be software calibrated with a PC computer connected to a serial communications port. The software allows a choice of calibration method between either single point calibration or two point calibration. Single point calibration allows only the zero value (offset) to be changed.

Two point calibration allows both zero and range to be calibrated independently.



INPUT SIGNALS

The Model 999 Corrector accepts inputs from gas meters equipped with a low frequency (LF) pulse output (voltage free contacts, transistor or mosfet), with a maximum frequency of 0.5 Hz. One input pulse defines the quantity of gas from the meter which can be scaled by the uncorrected volume factor giving the quantity of gas indicated on the display. Pulse rates up to 50 Hz can be accommodated using the built in pre-divider circuits.

The latter one is set by links in the Corrector.

PRESSURE INPUT

A specially designed pressure sensor is incorporated in the volume Corrector and maintains its high accuracy over a range of 1:10. The pressure sensors have been individually calibrated and characterized over the full range of pressures and temperatures. Their characteristics are stored within the sensor.

The Corrector uses these stored calibration data to compensate any temperature dependence or non-linearity. The sensors can therefore be exchanged without the need for re-calibration of the Corrector.

Sensors are available with the following pressure ranges :

| | | |
|-----------|----|------------|
| 0-2 bar | or | 0- 30 PSI |
| 0-3.5 bar | or | 0- 50 PSI |
| 0-5 bar | or | 0- 75 PSI |
| 0-7 bar | or | 0- 100 PSI |
| 0-10 bar | or | 0- 150 PSI |
| 0-17 bar | or | 0- 250 PSI |
| 0-25 bar | or | 0- 375 PSI |
| 0-40 bar | or | 0- 600 PSI |
| 0-60 bar | or | 0- 900 PSI |
| 0-80 bar | or | 0-1200 PSI |

Full accuracy is maintained between 10 % and 100 % of maximum working pressure.

The maximum overload pressure is 1.25 times the maximum working range of the sensor. The pressure connection is a 1/4" NPT female threaded stainless steel connector. All wetted parts are stainless steel.

The Corrector can be configured to display pressure in PSI, BAR, kPa or Kg/cm²

TEMPERATURE INPUT

The temperature sensor is a platinum resistance element with a nominal resistance of 100 Ω embedded in a 6mm stainless steel probe with a maximum pressure rating of 100 bar (1500 PSI). The standard probe has 3 meters (9 feet) of cable attached, screened with a stainless steel flexible sheath. The gas temperature range is -30°C to +60°C or -20°F to +140°F. Temperature can be configured to be displayed in °K, °C or °F.

ERRORS FAULTS AND ALARMS

The program and data memory are automatically tested by using checksum methods. All entered data is checked for corruption too. A watchdog circuit tests for correct microprocessor operation.

A FAULT is indicated if a failure is detected during these self checking procedures.

An ALARM is generated if the sensors are operating outside their range. This is also the case if a gasmeter input pulse is received before the last output pulse routine has been completed.

Apart from this, the user can define limiting values for pressure and temperature. Transgressing these limiting values can be monitored.

An alarm output can be generated for any one or any combination of either operation outside of the user defined limiting values, alarm or presence of a fault condition. The specific combination of conditions when such an alarm should occur can be programmed.

The output is an optically isolated open collector transistor used as a passive switch and rated as follows:

Maximum continuous voltage: 10 Vdc.
Maximum continuous current: 0,5 mA.

DEFAULT VALUES

A default value facility is provided where a pre-set value can be used for an active input in the flow calculation should that input go above or below the values set by the high and low alarm values.

The default facility is available on pressure and temperature.

The default facility can be deleted.

PULSE OUTPUTS

The Model 999 Corrector has two optically isolated collector outputs that can be used for pulse rate or status signals.

Both corrected and uncorrected volume can be allocated either to one or both outputs. Alternatively they may be used for volume in an alarm condition. The uncorrected output gives a pulse per unit of line volume (m^3 or ft^3 or decimal multiples thereof) taking account of the scaling of the input pulses.

The output can be divided by decimal factors of 0.1 to 1000. Each gasmeter pulse represents a specific line volume that is not necessarily equal to a unit of volume.

The corrected volume associated with the uncorrected line volume will be a factor F times the line volume. This factor is a function of pressure and temperature.

As it is impossible to generate fractional pulses, only the integer value is generated and the remainder is added when the next gasmeter pulse arrives. Similarly, if the uncorrected volume output pulse is scaled to the gasmeter pulse any remainder is handled in the same way. Both remainders can be accessed for checking purposes. The on and off period for each pulse can be selected to have a nominal duration of either 10 ms, 45 ms, or 360 ms and the maximum number of pulses per gasmeter pulse is 15.

The output is an optically isolated open collector transistor used as a passive switch and rated as follows:

Maximum continuous voltage: 10 Vdc.
Maximum continuous current: 0,5 mA.

These values may be limited by local safety requirements.

SERIAL PORTS

Three serial ports are provided which are used for the initial configuration and data entry to the Corrector and to give access to the logged data and audit data.

To enter or extract data from the Corrector it is necessary to use the software provided with the Corrector and a PC computer. The software

works in a Windows® environment. The 3 serial ports are :

- 1) An infrared communications port on the front cover of the Corrector.
- 2) A passive port using a Fischer connector at the side of the Corrector.
- 3) A RS232 port which can be active or passive on the internal terminal of the Corrector. (Active or passive determined by electrical safety requirements).

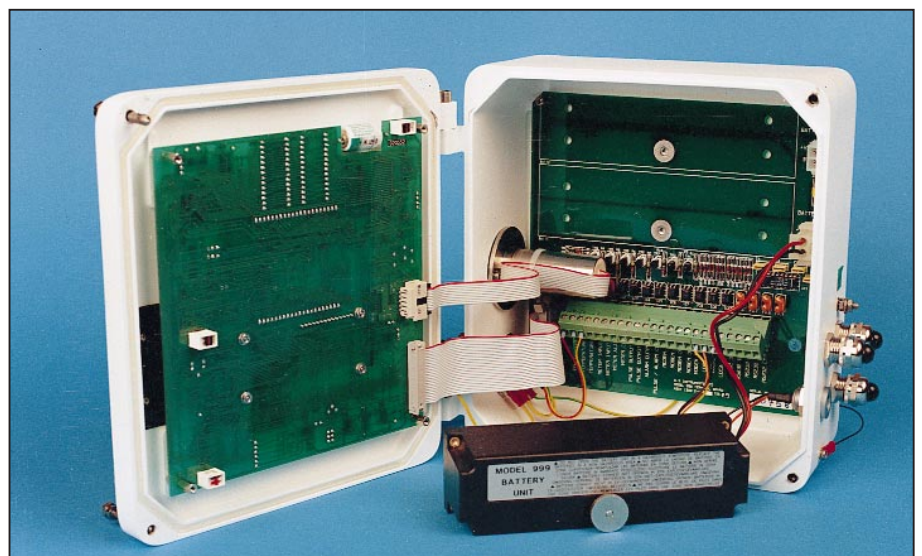
Each serial port can be configured to access, read or write different data to or from the Corrector. Security is maintained by having 3 levels of access, each level protected by a different password.

BATTERY POWER SUPPLY

The power for the Corrector is provided by a battery unit which contains two replaceable "D" size lithium cells.

When fitted with "D" cells of 19 Ah rating the unit will provide a nominal five years operation when the gasmeter frequency is 0.5 Hz. To achieve long battery life the LCD displays are normally blanked. When the battery is disconnected in order to be replaced, the Corrector is inoperative but the stored and displayed data is retained by a lithium back-up battery.

The capacity of this battery back-up is such that replacement should not be necessary during the life of the Corrector. It will provide back-up for up to 1000 hours without the main batteries being connected.



The Corrector has the option of fitting a second battery unit which, if connected permanently, will approximately double the time required between battery changes. A battery symbol is shown on the upper LCD display when the main batteries require replacing. The indication is given when power for approximately 1 month operation remains. BASEEFA Certificate No: Ex96D2007

ELECTRICAL SAFETY

The Model 999 Corrector is approved to the stringent CENELEC standards EN 50014 and EN 50020 as intrinsically safe to EEx ia II A T4. The units are manufactured at our BASEEFA approved factory which guarantees that these high safety standards are observed.

BASEEFA Certificate No: Ex96D2007. The Model 999 Corrector is highly immune to electrical interference and satisfies stringent requirements on the emission of electromagnetic radiation. Optional accessories are available to provide interfaces between hazardous and safe areas.

CONSTRUCTION

The Corrector is housed in a cast aluminium enclosure containing the pressure sensor, batteries and electronics. It is weather proof to IEC 144-IP66. The use of state of the art surface mount technology for the electronic circuits results in a very compact instrument.

Very high reliability is assured by the use of quality components and strict quality control. The Corrector is approved to European Standards for electromagnetic susceptibility and emission. It will operate accurately in environments with high levels of electromagnetic interference.

SELECTABLE DISPLAY PARAMETERS

Operation of the five magnetic buttons on the front of the corrector gives access to the following parameters:

- * Corrected Volume Total
- * Corrected Volume Remainder
- * Uncorrected Volume Total
- * Uncorrected Volume Remainder
- * Corrected Volume Total in an alarm condition

- * Corrected Volume Remainder in an alarm condition
- * Uncorrected Volume Total in an alarm condition
- * Uncorrected Volume Remainder in an alarm condition
- * Current day's Corrected Volume Total
- * Current day's Uncorrected Volume Total
- * Corrected Volume Flow Rate
- * Uncorrected Volume Flow Rate
- * Peak Hour Flow Rate
- * Time and Date of peak hour flow rate
- * Peak Day Flow Rate
- * Date of peak hour flow rate
- * Pressure with units of bara or psia
- * Temperature with units °C or °F
- * Time or flow weighted average pressure.
- * Time or flow weighted average temperature.
- * Correction Factor
- * Compressibility Factor
- * Compressibility at Base Conditions
- * Current Alarm Status
- * Clearing of logged data

SELECTABLE LOGGED PARAMETERS

Each of the 5 logging tables can be configured to log any of the following parameters:

- * Uncorrected volume
- * Corrected volume
- * Instantaneous pressure
- * Average Pressure
- * Instantaneous temperature
- * Average temperature
- * Correction factor
- * Uncorrected flow rate
- * Corrected flow rate

Each of these logger tables can be independently started and stopped and its time interval can be chosen independently. The logged data can be downloaded to a PC for further processing using the familiar Windows environment.

SECURITY

The Corrector has three levels of software security and two hardware security levels.

A hardware security switch can be set to inhibit any data changes allowing only data to be read from the Corrector.

A second security switch allows limited data to be changed and all data to be read from the Corrector.

Software security levels allow either all data to be programmed and read, limited data such as time, date and gas composition to be changed and all data to be read or no ability to change data but read all data.

Software security uses user identification and password codes.

DATA ENTRY PARAMETERS

The fixed parameters in the INSTROMET Model 999 Corrector are set using the serial data link connected to a PC.

The operating and configuration data are entered using user-friendly, familiar, Windows® based software and featuring extensive context sensitive "help" functions.

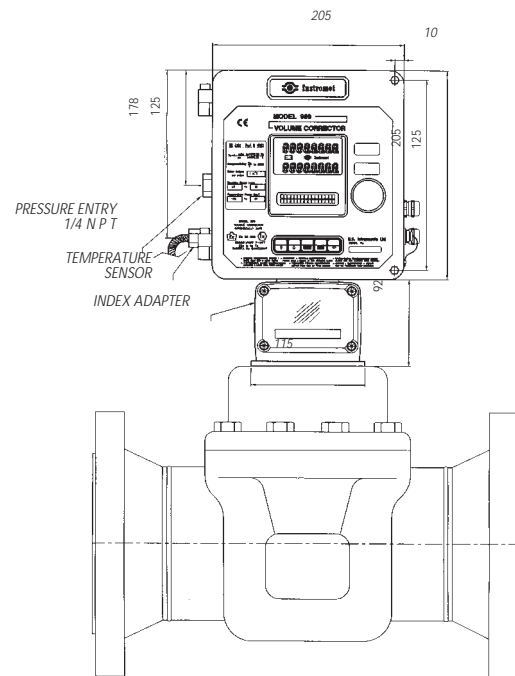
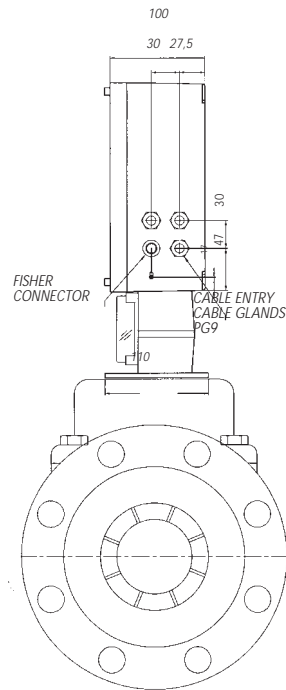
The configuration can be set-up on a PC without a corrector being connected. The configuration is then later downloaded to the corrector. It can also be saved and used as a template for other correctors, simplifying the set-up procedure even further. When installing and commissioning the INSTROMET Model 999 Corrector the index of corrected and of uncorrected volumes can be set.

This makes it possible for the uncorrected index to show the same value as the mechanical counter of the meter. Maximum and minimum values for temperature and pressure can be selected. The volume per pulse received from the gasmeter has to be entered. Base temperature and pressure can be set. To accurately correct for compressibility the gas parameters heating value, relative density (specific gravity), molar N2 and/or CO2 content have to be set. The software provides easy means to set the parameters related to alarm functions and associated default values. The pulse outputs are also configured using this software programme.

The compressibility factor Z is calculated according to AGA 8 or GERG using the measured values of pressure and temperature and the stored gas composition as parameters. Alternatively a fixed compressibility factor can be used.

MOUNTING AND DIMENSIONS

The Model 999 corrector can be fitted on most INSTROMET gas meters. For fitting to meters that are made in North America an integral index adapter can be supplied. The adapter can easily be changed to suit the direction of rotation of the meter. In addition it can be supplied for either pole or wall mounting.



DIMENSIONS IN mm

CORRECTION EQUATIONS

The Corrected Volume is calculated using the following:

$$V = N \cdot UC$$

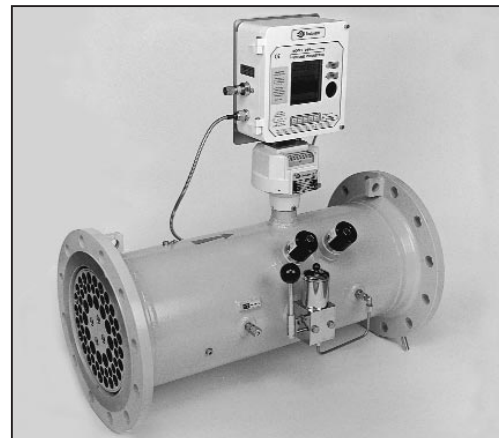
$$\text{and } V_n = V \cdot \frac{P}{P_b} \cdot \frac{t_b + T_0}{t + T_0} \cdot \frac{1}{K}$$

For gauge pressure sensors

$$P = P_g + P_a$$

where

- V = Line or uncorrected volume
- N = Number of pulses received from gasmeter
- UC = Uncorrected volume factor
- Vn = Volume corrected to base conditions
- P = Absolute Pressure
- P_b = Absolute base pressure
- t_b = Base temperature °C or °F or °K
- t = Gas temperature °C or °F or °K
- T₀ = Zero temperature (273.15 K or 459.67 R)
- K = Z/Z_b Compressibility ratio
- Z = Compressibility
- Z_b = Compressibility at base conditions
- P_g = Gas pressure (gauge)
- P_a = Atmospheric pressure (for gauge pressure sensors entered as P_{min})
- F = Correction factor



Instramet/SM-RI-X turbine gas meter with model 999 volume corrector

HOW TO ORDER

The following information will help us determine which corrector best suits your requirements.

- Model : 999 Volume Corrector
- Pressure sensor : range (select from page 4)
- Units : metric/imperial
- Temperature sensor : length 150/ 250 mm
- Calibration by : INSTROMET/
Weights and Measures
- Documents : Calibration certificate
Intrinsic Safety certificate

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