BASICS OF FLOW COMPUTERS

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TODAY’S AGENDA

- Overview of Electronic Measurement
- Basics of Electronic Flow Computers
- Overview of API 21.1 (AGA 13)
As natural gas and various hydrocarbons move from the well head to the burner tip, there are several electronic devices in the field used for measurement and control.
Electronic gas measurement (EGM) consists of a number of components which work together to measure and record gas flow.

The EGM includes the electronic measurement of Pressure (PT), Flow (FT), Temperature (TT) and/or Gas Analysis in order to calculate volume and energy quantity of Natural Gas.
ELECTRONIC GAS MEASUREMENT SYSTEM (EGM)

Volume and Energy Quantity Calculation Devices

- PI
- FI
- TI
- AI
- PT
- FT
- TT
- AT

Flow Element
MAIN ADVANTAGE OF ELECTRONIC FIELD DEVICES

- Name at least 3 advantages

  - Computing and signal processing power
  - Local data storage
  - Ability to communicate locally and remotely with other electronic devices or computers
IMPORTANCE OF FIELD MEASUREMENT DATA

- Timely
- Accurate
- Reliable
BASICS OF ELECTRONIC FLOW COMPUTERS
TRADITIONALLY....  AND... NOW....
ELECTRONIC FLOW COMPUTER
MAIN COMPONENTS

- Power Supply
- Processor & I/O Board
- Temperature Probe
- Local Communication Port
- Remote Communication Module
- Static & Differential Pressure Transmitter (MVT)
- Enclosure
- Local Display & Optional Keypad
POWER SUPPLY

- Battery Power
  - Alkaline or Lithium
  - Replace or Recharge

- AC/DC Power
  - UPS

- Solar Power
  - Solar Charger
**PROCESSOR BOARD (PCBA)**

- Brains of Flow Computer
- Flash Programming
  - Local calculations
- Low Power
  - Typically DC
- Inputs/Outputs
  - Analog/Digital
- Signal Conditioning
TRANSDUCER / TRANSMITTERS

- DP & P
  - Multi-variable (MVT)
  - Gauge or Absolute

- Temperature

- Multi-Run support

- Bi-directional
CONNECTIVITY

Remote Communication Options

Local Communication Options
REMOTE CONNECTIVITY

- Dial-up Modem
- Cellular Modem
- Wireless Radio
- Satellite
- Ethernet
- Bluetooth
FIELD SOFTWARE FOR CONFIGURATION & MAINTENANCE
REMOTE DATA COLLECTION
**INSTALLATION CONSIDERATIONS**

- Mounting
- Hazardous location
- Setup & configuration
  - Power setup
  - Flow parameter setup
  - Verification/calibration
  - Time/date
  - Communication setup/verification
- Surge protection
- Grounding
NOTE:
FOR BEST SURGE RESISTANCE, ELECTRICALLY ISOLATE THE METER SET FROM THE PIPELINE'S CATHODIC PROTECTION, AND SOLIDLY BOND TO SITE GROUND.

GROUND BED
CHECK WITH NATIONAL AND LOCAL ELECTRICAL CODES FOR PROPER GROUND BED SPECIFICATIONS.

(SEE NOTE)

CASE GROUND

#8 AWG OR LARGER

METER

SITE GROUND

RECOMMENDED PRESSURE CALIBRATION PORT (BY CUSTOMER)

PRESSURE LINE

PRESSURE TAP LOCATION MAY VARY WITH METER TYPE

TEMPERATURE PROBE
FLOW CALCULATIONS (EXAMPLE)

Differential Measurement API 14.3 Part 3 (AGA 3)

\[ Q_v = 7709.61 \, C_d \, (FT) \, E_v \, Y_d^2 \sqrt{\frac{P_{f1} \, Z_s \, h_w}{G_r \, Z_{f1} \, T_f}} \]
OTHER FLOW COMPUTER CAPABILITIES

- Historical Data Storage
  - Hourly
  - Daily
- Audit Trails
- Alarms
- Logic
- Control
- Additional calculations
- Additional communication protocols
API 21.1 OVERVIEW
API 21.1 OVERVIEW

- API 21.1 is an industry standard used for the measurement and recording of flow of natural gas for custody transfer applications utilizing industry recognized primary measurement devices.

- Minimum specifications for electronic gas measurement (EGM) systems are defined in API 21.1.
API 21.1 COMPONENTS

- Calculations
- Audit Trail and Records
- Data Availability
- Commissioning
- Equipment Verification and Validation
API 21.1 CALCULATIONS

- Orifice Meter (Differential pressure Measurement)
  - API MPMS Ch. 14.3 (AGA Report No. 3)
- Linear Meters – Rotary, Turbine, Diaphragm
  - AGA Report No. 7
- Equations of state for compressibility
  - AGA Report No. 8
The audit trail should include, but not limited to unedited historical data, event logs, field test reports, edit reasons, configuration logs and supported information for the accounted for mass, volume or energy.

API 21.1 refers to this as the Quantity Transaction Record (QTR)
Below is a sample of records (not all) that makeup a QTR:

- Date and time
- Quantity (volume, mass, and/or energy)
- Flow time
- Integral Value
- Meter output
- Static pressure average
- Temperature average
- Differential pressure average
Onsite data is typically stored in the flow computer of the EGM. Onsite data requirements for API 21.1 are summarized below:

- Minimum of seven days of hourly QTRs
- Minimum of seven days of daily operational data
- Constant flow parameters and manually entered input variables that affect quantity calculations
- Current values for live input variables or calculated variables
- Current value of gas analysis data
- Equipment information
Commissioning is the process of the initial verification and documentation that the EGM system is installed and functioning according to its specifications, design, and regulatory/contractual requirements.

The following EGM components require verification/calibration:
- Static pressure transmitters
- Differential pressure transmitters
- Temperature transmitters
- On-line analyzers
- Other EGM devices
SECURITY/DATA INTEGRITY

- All data records as required in API 21.1, shall be stored in such a way they cannot be altered.
- Procedures shall be implemented to detect deleted or missing records.
- Both original and edited data must be retained.
- The electronic flow computer shall provide a battery backup capable of storing all data in the unit’s memory for no less than 35 days.
Contact Information

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THANK YOU