BASICS OF FLOW COMPUTERS

Jereme Stewart

Eagle Research Corporation

EAGLE RESEARCH CORPORATION

TODAY'S AGENDA

- Overview of Electronic Measurement
- Basics of Electronic Flow Computers
- Overview of API 21.1 (AGA 13)

ELECTRONIC MEASUREMENT

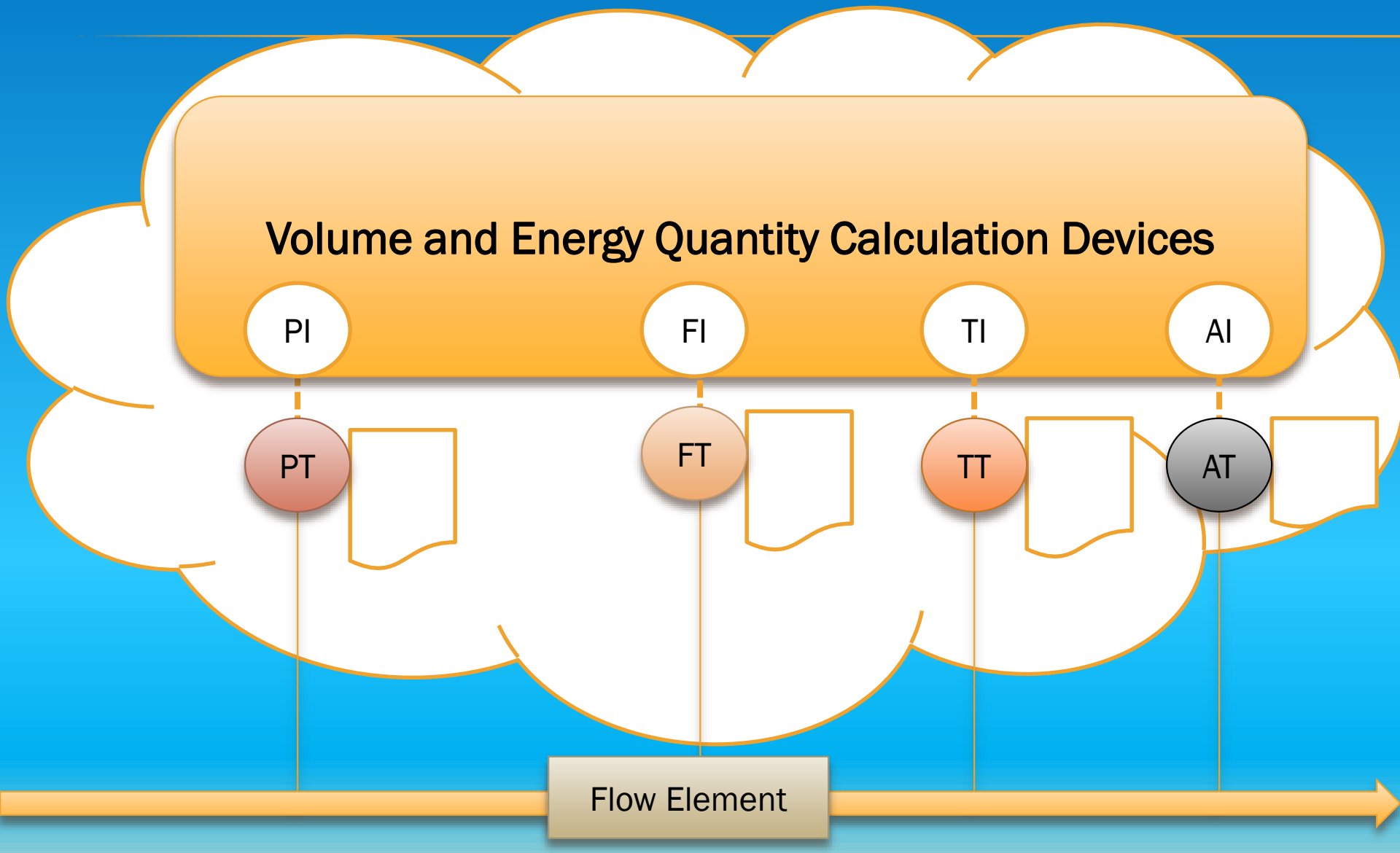
- As natural gas and various hydrocarbons move from the well head to the burner tip, there are several electronic devices in the field used for measurement and control.

ELECTRONIC GAS MEASUREMENT (EGM)

- 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)



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

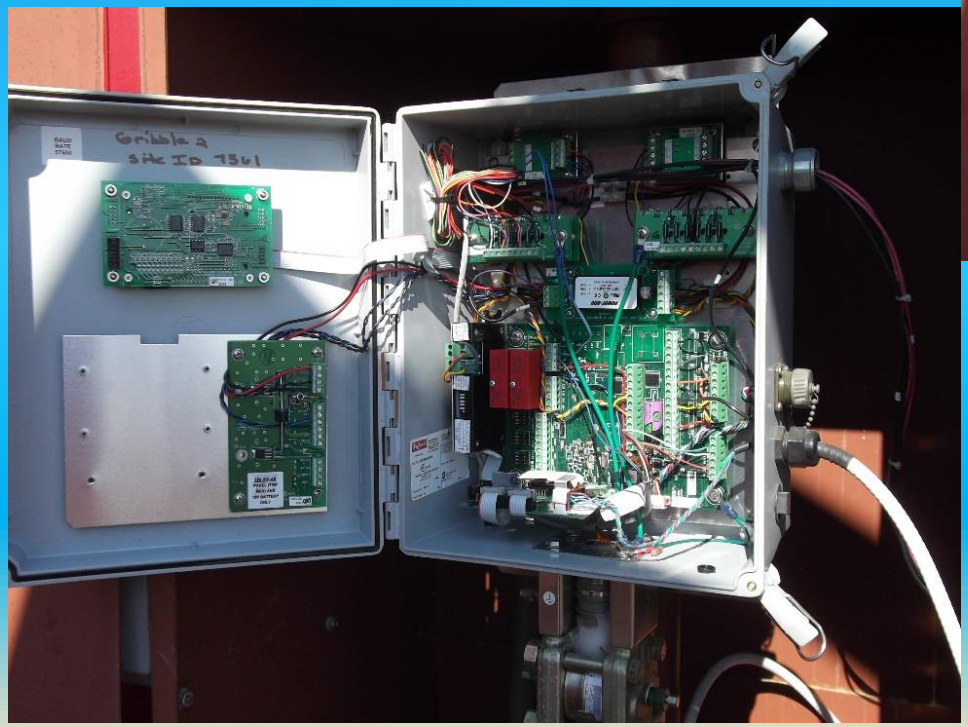
Timely

Accurate

Reliable

BASICS OF ELECTRONIC FLOW COMPUTERS

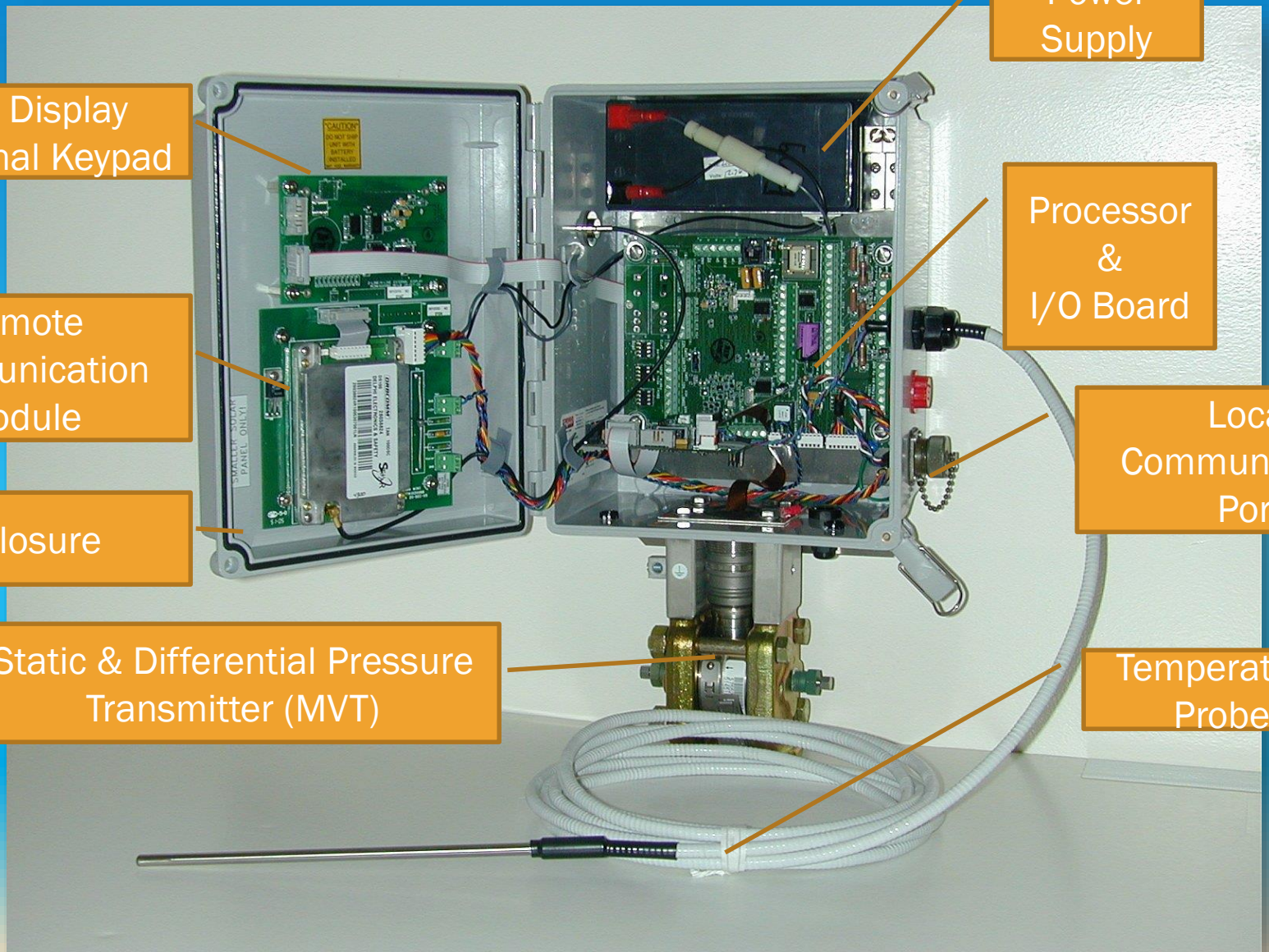
FLOW COMPUTER EXAMPLES



08.14.2007 02:03

TRADITIONALLY…. AND… NOW….

ELECTRONIC FLOW COMPUTER MAIN COMPONENTS

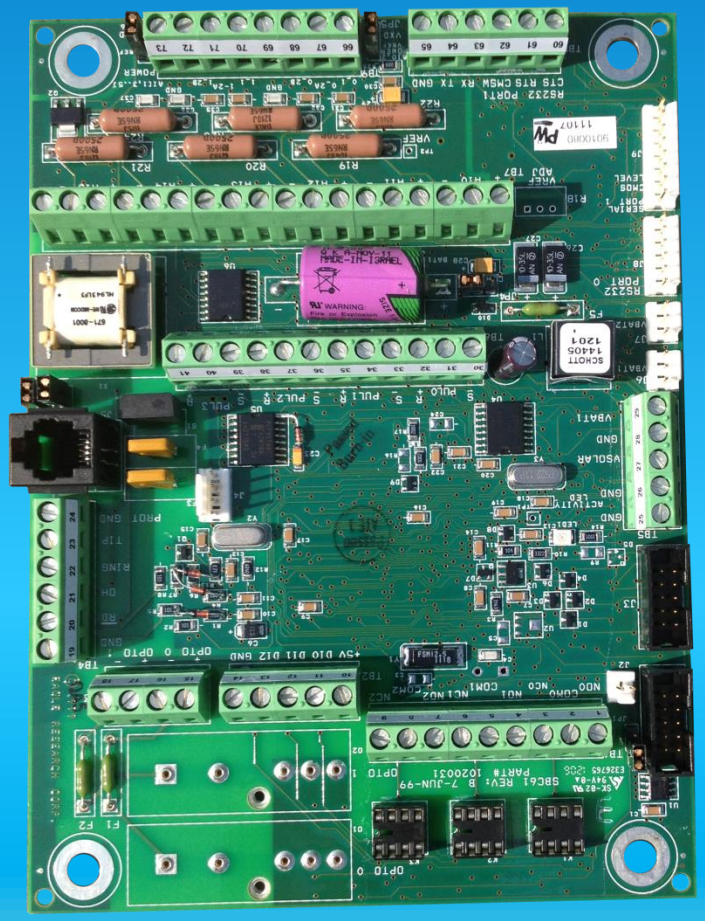


POWER SUPPLY

- Battery Power
  - Alkaline or Lithium
  - Replace or Recharge
- AC/DC Power
  - UPS
- Solar Power
  - Solar Charger

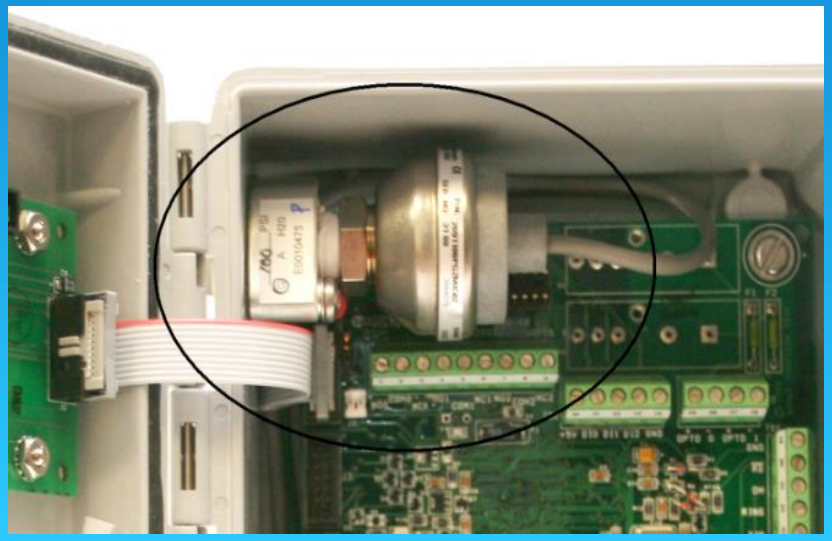
PROCESSOR BOARD (PCBA)

- 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

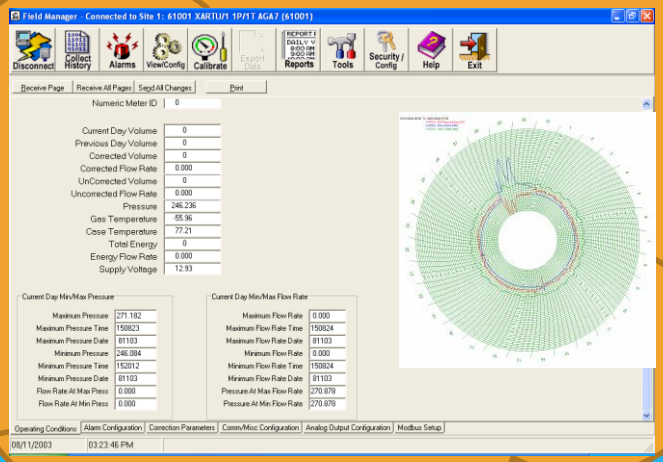
Remote Communication Options

Local Communication Options

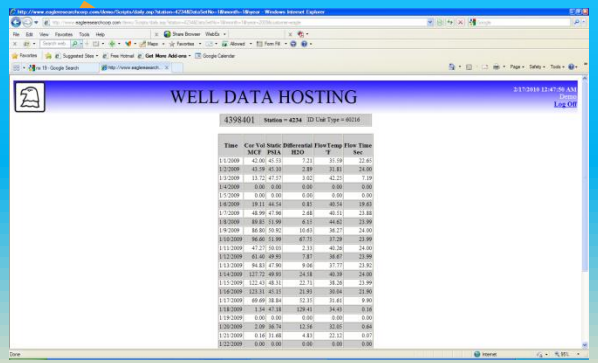
REMOTE CONNECTIVITY

- Dial-up Modem
- Cellular Modem
- Wireless Radio
- Satellite
- Ethernet
- Bluetooth

FIELD SOFTWARE FOR CONFIGURATION & MAINTENANCE

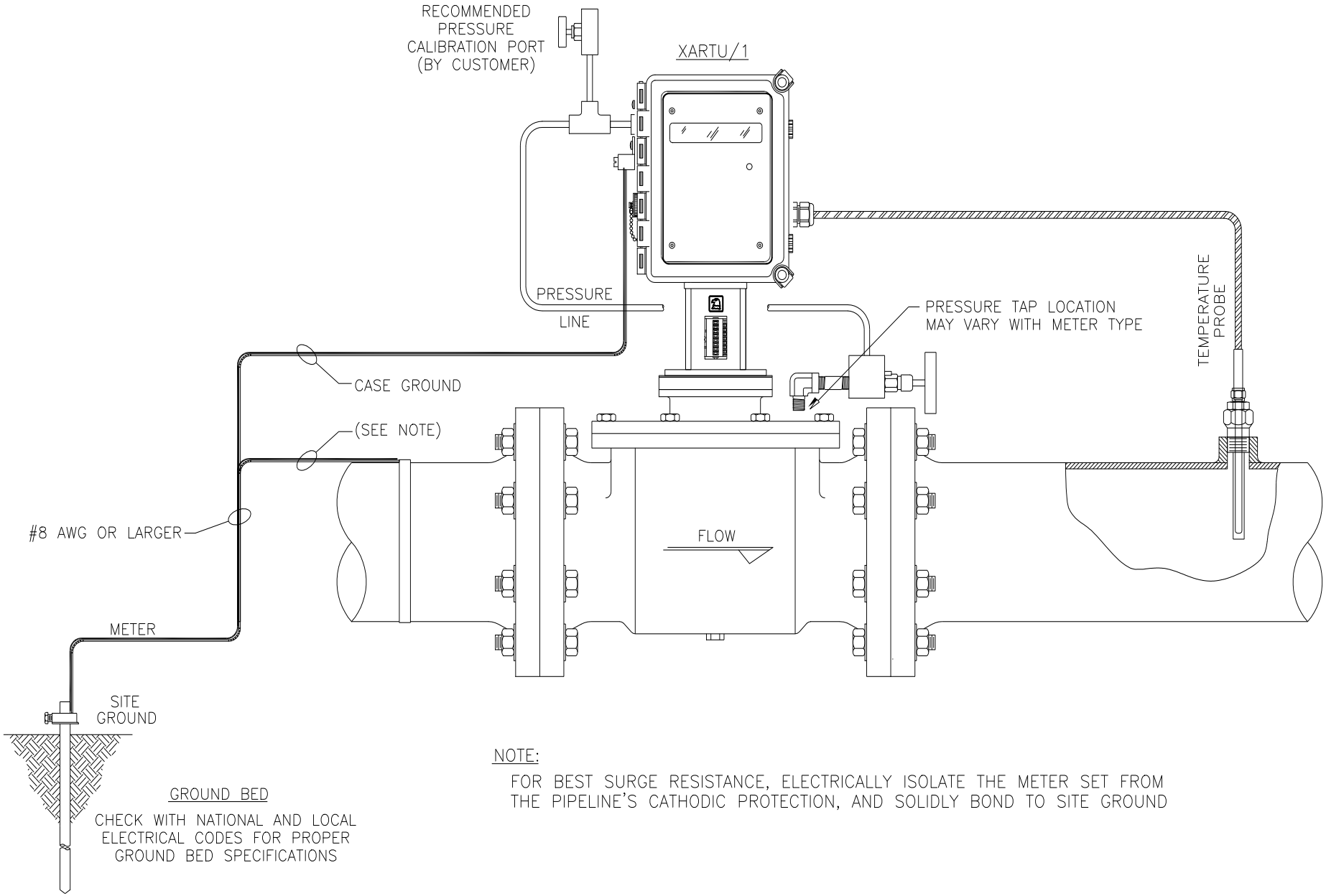


REMOTE DATA COLLECTION



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

FLOW CALCULATIONS (EXAMPLE)

Differential Measurement API 14.3 Part 3 (AGA 3)

$$Q_v = 7709.61\, C_d\, (FT)\, E_V Y d^2 \sqrt{\frac{P_{f_1} Z_s h_w}{G_r Z_{f_1} T_f}}$$

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 and 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

API 21.1 AUDIT TRAIL AND RECORDS

- 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)

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

DATA AVAILABILITY

Onsite data is typically store 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/VERIFICATION

- 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

Eagle Research Corporation
1079 St Route 34
Hurricane, WV 25526
(304)-757-6565
Email: Jereme.Stewart@eagleresearchcorp.com
Web: www.eagleresearchcorp.com

THANK YOU