



SOUTHWEST GAS CORPORATION
ENGINEERING STAFF
MATERIAL SPECIFICATION

Prepared By: Engineering Staff 
Approved By: Jerome T. Schmitz 

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ELECTRONIC MEASUREMENT

Electronic Pressure and/or Temperature Volume Correctors and Pressure Recorders

1. SCOPE

This material specification covers Electronic Volume Correctors (EVC), Electronic Pressure Recorders (EPR) and Programmable Logic Controllers (PLC). EVC's and PLC's are to be used in conjunction with natural gas positive displacement, rotary and turbine meters to correct pressures and temperature that are not at base conditions. PLC's are to be used in conjunction with previous stated meter types, orifice and ultrasonic meters to correct pressures and temperatures that are not at base conditions and allow for remote/local monitoring and control of pressure or flow rates through scaled inputs/outputs from/to auxiliary equipment such as pressure and temperature transmitters and control valves and be capable of being programmed for other applications as required by SWG. EPR's are to be used in natural gas pressure monitoring applications as a replacement for mechanical chart recorders.

2. APPLICABLE DOCUMENTS

- 2.1 American Gas Association (AGA) Report 7, "Measurement Turbine Meters."
- 2.2 American Gas Association (AGA) Report 8, "Compressibility and Super Compressibility for Natural Gas and other Hydrocarbon Gases."
- 2.3 American Gas Association (AGA) NX-19, "Super Compressibility."
- 2.4 American National Standards Institute (ANSI/ISA), S-12.12, "Electrical Equipment for Use in Class 1, Division 2, Hazardous Areas."
- 2.5 American National Standards Institute (ANSI) B-109.2, "Diaphragm Type Gas Displacement Meters."
- 2.6 American National Standards Institute (ANSI) B-109.3, "Rotary Type Gas Displacement Meters."
- 2.7 American National Standards Institute (ANSI/NEMA) 250, "Enclosures for Electrical Equipment."
- 2.8 ASTM International (ASTM) A-269, "Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service."
- 2.9 International Electrotechnical Commission (IEC) 751, "Platinum, 100 Alpha=.00385 Resistance as a Function of Temperature."



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2. APPLICABLE DOCUMENTS (Cont'd)

- 2.10 American National Standards Institute (ANSI) 913-1988, "Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous Locations."
- 2.11 National Electric Code (NEC), Article 500.
- 2.12 Southwest Gas (SWG) Material Specification (MS) Q-2, "Thermowells."
- 2.13 United States Department of Transportation (DOT), Code of Federal Regulations, Title 49, Part 192, "Transportation of Natural Gas by Pipeline; Minimum Safety Standards."

NOTE: Unless otherwise specified, the editions of the above documents incorporated by DOT 49 CFR 192 are applicable. Documents not incorporated by DOT 49 CFR 192 will be the most recent edition.

3. TERMINOLOGY

3.1 General

- 3.1.1 "Southwest Gas," "Southwest" or "SWG" wherever used in this specification and other related documents will refer exclusively to Southwest Gas Corporation.
- 3.1.2 The terms "approved," "as approved," "satisfactory," "as directed," "or equal" or other similar terms wherever used in this specification and other related documents will mean "as determined by Southwest Gas," unless specifically stated otherwise.
- 3.1.3 "Product Information Package" or "PIP," wherever used in this specification and other related documents will mean the required technical product information that a manufacturer must submit to SWG to determine if the product is suitable for use by SWG, unless specifically stated otherwise.



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3. TERMINOLOGY (Cont'd)

3.2 Specific

- 3.2.1 “Data Communicator,” wherever used in this specification and other related documents will encompass all associated interfaces and appropriate hardware/software used for local and remote interrogation and communication.
- 3.2.2 “Enhanced Application” wherever used in this specification and other related documents will refer to EPR and EVC Systems equipped with remote communications, measurement, history and audit trail (event log) capabilities.
- 3.2.3 “EPR System,” wherever used in this specification and other related documents will mean Electronic Pressure Recorder including any ancillary equipment and software required for the approved application necessary for the system’s successful operation.
- 3.2.4 “EVC System,” wherever used in this specification and other related documents will mean Electronic Volume Correctors which may include electronic pressure and temperature correctors and flow computers, including any ancillary equipment and software required for the approved application necessary for the system’s successful operation.
- 3.2.5 “EVCR Systems,” wherever used in this specification and other related documents will mean Electronic Volume Corrector or Recorder and the specification that applies to both EPR and EVC Systems.
- 3.2.6 “Hazardous Locations” or “Classified Areas,” wherever used in this specification and other related documents will mean Class I, Group D, Divisions 1 and 2 as defined in the National Electric Code, Article 500.



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3. TERMINOLOGY (Cont'd)

3.2 Specific (Cont'd)

- 3.2.7 “PLC System” wherever used in this specification and other related documents will mean Programmable Logic Controller or Distributed Process Controller including any ancillary equipment and software required for the system’s successful operation. This does not apply to any equipment that is connected to the input/output terminals of the PLC, such as meters, pressure transmitter, etc. as they are covered under their own material specifications.
- 3.2.8 “RTU Systems,” wherever used in this specification and other related documents will mean EVCR Systems or PLC Systems and the specification that applies to both EVCR and PLC Systems.
- 3.2.9 “SCADA”, wherever used in this specification or other related documents will mean SWG’s Supervisory Control and Data Acquisition System.
- 3.2.10 “Stand-Alone Application” wherever used in this specification and other related documents will refer to EVC Systems which has a self-contained power system and does not have remote data communications equipment connected.
- 3.2.11 “Standard or Base Conditions,” wherever used in this specification and other related documents will mean a standard pressure of 14.73 psia and a standard temperature of 60°F (15.5°C).



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4. MATERIALS AND MANUFACTURING

4.1 EVC Systems

- 4.1.1 All EVC Systems will be capable of direct mounting on meters used by SWG and, if available as a standard option, a separate index pulsar assembly for remote installation of the EVC.
- 4.1.2 The EVC System will contain a mechanical index counter with a minimum of six (6) visible digits.
- 4.1.3 The index will register uncorrected volume accumulation from meters ranging from 5 cf, 10 cf, 100 cf and 1000 cf per revolution. Masking kits will be provided to identify the meter drive rate on the index.
- 4.1.4 On the index, the gas meter rotation should be visible for local test and calibration.
- 4.1.5 Index to meter couplings will be designed so meter drive rotation can be easily changed in the field.
- 4.1.6 The transfer torque from the gas meter to index will be less than 0.5 inch ounces and will not be affected by mechanical shock or vibration and electric or magnetic interference.
- 4.1.7 The thermal sensor will be a Resistive Temperature Device (RTD) and meet the requirements of IC-751 or another SWG approved device.
- 4.1.8 Thermal sensor will have an accuracy of $\pm 0.2^{\circ}\text{F}$ for a calibrated range of -20°F to 140°F (-29°C to 60°C) and drift will not exceed $\pm 0.2^{\circ}\text{F}$ of the full scale calibrated range for 12 months.
- 4.1.9 Thermal sensor will be encased in a stainless steel sheath forming a probe having a 0.250 inch nominal outside diameter and a 6 inch nominal insertion length.
- 4.1.10 The thermal probe cable assembly will be an electrically shielded corrosion resistant cable.



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4. MATERIALS AND MANUFACTURING (Cont'd)

4.2 EVC Systems (Cont'd)

- 4.2.1 The thermal probe cable assembly standard length will be 6 feet with optional lengths of 15 and 30 feet.
- 4.2.2 The thermal probe will be equipped with a metal ¼ inch tubing to ½ inch NPT male connector or a similar SWG approved fitting to allow probe insertion length adjustment, provide mechanical support and sealing of the thermowell.

4.3 EVCR Systems

- 4.3.1 EVCR System enhanced applications will have a real time clock with an accuracy of ± 30 seconds per month.
- 4.3.2 EVCR Systems will have a keyboard or scroll switch to access selective data or pre-programmed, pre-selected data.
- 4.3.3 EVCR Systems will have a minimum 6-digit electronic display, which can be used to calibrate, configure or retrieve information from the EVCR System.
- 4.3.4 All gas carrying pressure components used in EVCR Systems, other than the pressure transducer, will have a minimum burst pressure rating of 3000 psig.
- 4.3.5 The pressure measurement transducer will be in gauge (psig) and capable of operating at altitudes of 200 to 8,000 feet above sea level.
- 4.3.6 The pressure transducer combined accuracy, including linearity, hysteresis temperature effects and repeatability will be ± 0.25 percent or better for the full scale calibration range.
- 4.3.7 The maximum measurement pressure range acceptable to SWG is 0 to 1500 psig.
- 4.3.8 The pressure transducer will be capable of withstanding 150 percent over pressure of its rated range without affecting its accuracy.
- 4.3.9 The pressure transducer will have a minimum burst pressure of two times its pressure range.



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4. MATERIALS AND MANUFACTURING (Cont'd)

4.4 PLC Systems

- 4.4.1 PLC Systems will have a real time clock with an accuracy of ± 30 seconds per month.
- 4.4.2 The PLC System will have onboard, input/output and communication terminals and/or ports to allow expansion input/output and communication modules to be installed.
- 4.4.3 The Analog Input(s), Digital Input(s), Digital Output(s), etc. must be electrically isolated from the PLC's bus interface circuitry or have surge suppression included in the I/O circuitry.
- 4.4.4 The Analog Input(s) must be capable of accepting a 4-20 ma or 1-5 volt input and should have the ability of selectable MA or Voltage input or have the ability to have the input modules replaced so that the input range can be properly configured.
- 4.4.5 The Analog Input(s) shall be capable of providing full operational electrical power to the connected device while at the same time measuring the 4-20 ma/1-5V analog signal or be capable of accepting a 12 or 24 Volt DC external power source to the connected device and at the same time measuring the 4-20ma/1-5V signal in the circuit from the connected device.
- 4.4.6 The Analog Output(s) should be, by programming or jumpers, individually configurable for 1-5V or 4-20ma operation and either internally sourced and capable of providing full operational electrical power to the connected device or capable of accepting an external power source to operate the attached device.
- 4.4.7 The Digital Input(s) should be selectable, by programming or jumpers, for either external power sourced Digital Input or internally powered dry contact Digital Input operation.
- 4.4.8 The Digital Input(s) should have a selectable, by programming or jumpers, "Debounce" circuitry to eliminate spurious pulses caused by relay contact bounce, etc. or to turn off the "Debounce" option if it is not required.



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4. MATERIALS AND MANUFACTURING (Cont'd)

4.4 PLC Systems (Cont'd)

4.4.9 High Speed Counter Inputs for high frequency digital inputs should have a selectable, by programming or jumper, "Debounce" circuitry to reduce or eliminate spurious pulses.

4.5 RTU Systems

4.5.1 RTU Systems, including all supplied options, will have a minimum certification of Class I, Division 2, Group D by either Underwriters Laboratories (UL), Factory Mutual (FM) or Canadian Standards Authority (CSA).

4.5.2 Materials used in the RTU Systems that are in direct contact with natural gas will be compatible with natural gas and other agents commonly found in natural gas pipelines.

4.5.3 Plastic materials used in the RTU Systems will contain suitable ultraviolet inhibitors which are acceptable to SWG, so that the materials physical properties will not be adversely affected by exposure to natural ultraviolet light in locations throughout SWG's service area.

4.5.4 All RTU System equipment enclosures will be ANSI/NEMA Type 4 or 4X or SWG approved equivalent.

4.5.5 RTU Systems will have sufficient Random Access Memory (RAM) which can be used for storing all data required by SWG.

4.5.6 RTU Systems RAM memory will not be lost due to power failure from the main battery or other system power source.

4.5.7 RTU Systems, where applicable, will provide unit generated signals of pulse outputs for corrected and uncorrected volume accumulations and, if available, a 4 to 20 milliamp signal for flow rate.



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4. MATERIALS AND MANUFACTURING (Cont'd)

4.5 RTU Systems (Cont'd)

4.5.8 RTU Systems, when specified, will provide local and remote communication capabilities for data communicators to provide access to RTU Systems live and computational data.

- Data port(s) for SWG SCADA System will be RS-232 levels with a standard baud rate of 9600 baud with higher baud rates as options.
- Additional data ports will have the option of choosing RS-232 or RS-485 levels.
- Units with embedded phone modems will be Bell 102/212 or v.22/v.22bis.
- For units used with dial up modems, a 2400 baud rate standard with 1200 baud rate optional for SWG SCADA System.

4.5.9 RTU Systems will be capable of being remotely configured, initiating and receiving scheduled and non-scheduled remote communication requests, and allow remote termination of communication requests.

4.5.10 All RTU System data communications will be compatible with SWG's SCADA System. All requested data shall be date and time stamped or marked/ordered in an equivalent unambiguous manner, and all data transmitted from the RTU System will have error detection code embedded in each message block such as a checksum or CRC code.

4.5.11 The RTU System will comply with all relevant Federal Communications Commission rules for electromagnetic radiation and applicable telecommunications interfaces.

4.5.12 The RTU System communications software, when required, will be licensed to SWG for unlimited internal distribution and use.



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4. MATERIALS AND MANUFACTURING (Cont'd)

4.5 RTU Systems (Cont'd)

4.5.13 If the RTU System enclosures are used, the following requirements need to be included:

- The exterior of metal enclosures will be coated with a white or other approved color, as specified by the purchase order, using a dry powder fuse bonded polyester containing UV stabilizers or other approved coating.
- The exterior of the non-metallic enclosure will have the color impregnated within the resin and meet the UV protection requirements of paragraph 4.3.
- The RTU System enclosure must be secured from unauthorized access by the following methods: Enclosures equipped with lockable draw-pull latch assembly will be corrosion resistant and will be capable of accepting a SWG provided lock. Enclosures that use screw fasteners to secure a lid or access panel will be equipped to either accept a SWG provided lock, tie wire seal or some other SWG approved seal to indicate tampering.

4.5.14 Each RTU System, that is capable of an automatic power fail restart and equipped with a real time clock will maintain the correct time and date for a period of 30 days in the event of a power loss from the main battery or other system power source.



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5. PERFORMANCE REQUIREMENTS

5.1 EPR Systems

5.1.1 EPR System applications will selectively retrieve and display, without additional interrogation equipment, the following data:

- Live Pressure
- Additional Live Pressure(s), if equipped
- Unit Alarms
- Battery Voltage

5.1.2 EPR Systems will consist of and have access to the following items for programming, configuring and evaluating:

- Time
- Date
- Station ID
- Baud Rate and Other Modem Control Parameters (where applicable)
- Call Out Parameters (where applicable)
- High/Low Pressure Alarms
- Pressure Transducer Calibration Table
- Sample or Wake-up Interval
- Engineering Units
- Alarm Acknowledge
- Firmware Revision



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.1 EPR Systems (Cont'd)

5.1.3 EPR System programming will consist of and have access to the following for scaling, configuring or evaluating:

- Pressure Range
- Additional Analog Inputs, if equipped
- Digital Inputs, if equipped

5.1.4 EPR System Audit Trail will maintain a record of event or activities that can impact the accuracy of the unit and record the source, nature, time and date of the following events or activities:

- Changes of Time or Date
- Changes of the Unit's Configuration
- Changes of Scale Factors or Constants
- Calibration Activities
- Unit Alarms such as Open Door (tamper) if present, Transducer Failure, A/D Over Range, Power and Other System Alarms

5.1.5 EPR System Audit Trail will maintain a record of a minimum of 50 events or activities before an upload reset, or if it is a circular file, the oldest entry is overwritten.



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.1 EPR Systems (Cont'd)

5.1.6 EPR System historian will provide 35 days of storage with a maximum of 5 minute historian logging intervals with selective retrieval of the following at a minimum:

- Daily Pressure
- Additional Pressure
- Daily High Pressure per Pressure Input
- Daily Low Pressure per Pressure Input
- Pressure Reading of Each Transducer at Every Logging Interval
- Time and Date Stamp of All Readings

5.2 EVC Systems

5.2.1 The EVC System gas volume calculations will be based on the following American Gas Association (AGA) Reports: AGA #7 for Turbine Meters and AGA #3 for Orifice Metering and either NX-19 or AGA #8 for determining super compressibility correction factor. The EVC System will provide the super compressibility calculation method as a selectable option.

5.2.2 Without any additional interrogation equipment the following data will be selected, retrieved and displayed only (wherever applicable) by the EVC "Stand Alone" System:

- Corrected Volume Index in Mcf
- Uncorrected Volume Index in Mcf
- Flow Rate
- Total Correction Factor
- Live Pressure
- Live Temperature
- Battery Voltage
- Unit Alarms



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.3 The EVC "Stand Alone" System programming will consist of and have access to the following for unit configuring and or evaluating:

- Pressure Transducer Calibration Table
- High/Low Pressure Alarms
- Alarm Acknowledge
- Engineering Units
- Sample or Wake-up Interval
- Firmware Revision

5.2.4 The EVC "Stand Alone" System programming will consist of and have access to the following for scaling or evaluating:

- Pressure Range
- Temperature Range
- Gas Meter Scale Factor
- Corrected Volume Scale Factor
- Pulse Output Scale Factor Uncorrected Volume
- Pulse Output Scale Factor Corrected Volume

5.2.5 The EVC "Stand Alone" System programming will consist of and have access to the following constants and gas quality data for pre-loading values or evaluating:

- Uncorrected Volume Accumulation Index (Electronic)
- Corrected Volume Accumulation Index
- Fixed Factor Pressure
- Fixed Factor Temperature
- Fixed Factor Super Compressibility



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.6 The EVC "Stand Alone" System programming will consist of and have access to the following constants and gas quality data for pre-loading values or evaluating:

- Base Pressure
- Base Temperature
- Atmospheric Pressure
- Specific Gravity
- Mol % CO₂
- Mol % Nitrogen

5.2.7 The EVC "Stand Alone" System, wherever applicable, will have access to the following calculated values:

- Flow Rate
- Ambient Temperature
- Total Volume Correction Factor
- Pressure Correction Factor
- Temperature Correction Factor
- Super-compressibility Factor

NOTE: Portions of Stand Alone requirements may be waived by SWG for specialized applications



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.8 Without any additional interrogation equipment the following data will be selected, retrieved and displayed only (wherever applicable) by the EVC "Enhanced" System:

- Corrected Volume Index in Mcf
- Uncorrected Volume Index in Mcf
- Flow Rate (Instantaneous)
- Total Correction Factor
- Live Pressure
- Live Temperature
- Previous Day Corrected Volume
- Previous Day Uncorrected Volume
- Battery Voltage
- Unit alarms

5.2.9 The EVC "Enhanced" System programming will consist of and have access to the following for unit configuring and or evaluating:

- Time
- Date
- Station ID
- Baud Rate and Other Modem Control Parameters (where applicable)
- Call Out Parameters (where applicable)
- High/Low Pressure Alarms
- Pressure Transducer Calibration Table
- Sample or Wake-Up Interval
- Engineering Units
- Alarm Acknowledge
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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.10 The EVC “Enhanced” System programming will consist of and have access to the following for scaling or evaluating:

- Pressure Range
- Temperature Range
- Gas Meter Scale Factor
- Corrected Volume Scale Factor
- Pulse Output Scale Factor Corrected Volume
- Pulse Output Scale Factor Uncorrected Volume

5.2.11 The EVC “Enhanced” System programming will consist of and have access to the following for pre-loading values or evaluating:

- Uncorrected Volume Accumulation Index (Electronic)
- Corrected Volume Accumulation Index
- Previous Hour Corrected Volume
- Fixed Factor Pressure
- Fixed Factor Temperature
- Fixed Factor Super Compressibility

5.2.12 The EVC “Enhanced” System programming will consist of and have access to the following constants and gas quality data for pre-loading values or evaluating:

- Base Pressure
- Base Temperature
- Atmospheric Pressure
- Specific Gravity
- Mol % CO₂
- Mol % Nitrogen



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.13 The EVC "Enhanced" System wherever applicable, will have access to the following calculated values:

- Flow Rate
- Ambient Temperature
- Total Volume Correction Factor
- Pressure Correction Factor
- Temperature Correction Factor
- Super Compressibility Factor

5.2.14 The EVC "Enhanced" System historian will provide at least 6 days of storage plus current day with selective retrieval of the following:

- Daily Corrected Volume in Mcf
- Daily Uncorrected Volume in Ccf
- End of Gas Day Total Corrected Volume Accumulation in Mcf
- End of Gas Day Total Uncorrected Volume Accumulation in Ccf
- Daily Peak Flow Rate in Mcf/Hr (optional)
- Daily Peak Flow Rate in Time Stamp (optional)
- Daily Average Pressure
- Daily Average Temperature
- Previous Hour Corrected Volume in Mcf



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.2 EVC Systems (Cont'd)

5.2.15 The EVC "Enhanced" System will maintain a record of event or activities that can impact the accuracy of the unit and record the source, nature, time and date of the following events or activities:

- Change of Time or Date
- Changes of the Unit's Configuration
- Changes of Scale Factors or Constants
- Calibration Activities
- Unit Alarms such as Open Door (tamper) if applicable, Transducer Failure, A/D Over Range, Power and Other Systems

5.2.16 The EVC "Enhanced" System will maintain a record of a minimum of 50 events or activities before an upload reset, or if it is a circular file, the oldest entry is over written.

5.3 EVCR Systems

5.3.1 EVCR Systems will have a total accuracy of $\pm 0.5\%$ including computation, linearity, repeatability, hysteresis and temperature effects at the following conditions:

- Pressure Range of 25% to 95% of Full Scale
- Gas Temperature Range 32°F to 125°F (0°C to 51.67°C).
- Ambient Temperature Range -20°F to 150°F (-28°C to 65.6°C)
- Meter Pressure, Gas and Ambient Temperature are steady during Measurement/Calculation Period.



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Electronic Pressure and/or Temperature Volume Correctors and Pressure Recorders

5. PERFORMANCE REQUIREMENTS (Cont'd)

5.3 EVCR Systems (Cont'd)

5.3.2 EVCR System pressure and temperature calibration will consist of zero and 100 percent of scale with a linearity check at 50 percent of scale.

5.3.3 EVCR Systems that use a pressure transducer error correcting table or algorithm will also contain the transducer's serial number. The correcting table or algorithm will be accessible for review, evaluation and validation.

5.4 PLC Systems

5.4.1 The PLC System programming will consist of and have access to the following for unit configuring and or evaluating:

- Time
- Date
- Station ID
- Baud Rate and other Modem Control Parameters (where applicable)
- Call Out Parameters (where applicable)
- High/Low Pressure Alarms
- Pressure Transducer Calibration Table
- Sample or Wake-Up Interval
- Engineering Units
- Alarm Acknowledge
- Firmware Revision



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.4 PLC Systems (Cont'd)

5.4.1 The PLC System programming will consist of and have access to the following for scaling or evaluating:

- Pressure Range
- Temperature Range
- Gas Meter Scale Factor
- Corrected Volume Scale Factor
- Pulse Output Scale Factor Corrected Volume
- Pulse Output Scale Factor Uncorrected Volume

5.4.2 The PLC System programming will consist of and have access to the following for pre-loading values or evaluating:

- Uncorrected Volume Accumulation Index (Electronic)
- Corrected Volume Accumulation Index
- Previous Hour Corrected Volume
- Fixed Factor Pressure
- Fixed Factor Temperature
- Fixed Factor Super Compressibility

5.4.3 The PLC System programming will consist of and have access to the following constants and gas quality data for pre-loading values or evaluating:

- Base Pressure
- Base Temperature
- Atmospheric Pressure
- Specific Gravity
- Mol % CO₂
- Mol % Nitrogen



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.4 PLC Systems (Cont'd)

5.4.4 The PLC System, wherever applicable, will have access to the following calculated values:

- Flow Rate
- Ambient Temperature
- Total Volume Correction Factor
- Pressure Correction Factor
- Temperature Correction Factor
- Super Compressibility Factor

5.4.5 The PLC System historian will provide at least 6 days of storage plus current day with selective retrieval of the following:

- Daily Corrected Volume in Mcf
- Daily Uncorrected Volume in Ccf
- End of Gas Day Total Corrected Volume Accumulation in Mcf
- End of Gas Day Total Uncorrected Accumulation in Ccf
- Daily Peak Flow Rate in Mcf/Hr (optional)
- Daily Peak Flow Rate Time Stamp (optional)
- Daily Average Pressure
- Daily Average Temperature
- Previous Hour Corrected Volume in Mcf



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.4 PLC Systems (Cont'd)

5.4.7 The PLC System audit trail will maintain a record of event or activities that can impact the accuracy of the unit and record the source, nature, time and date of the following events or activities:

- Changes of Time or Date
- Changes of the Units' Configuration
- Changes of Scale Factors or Constants
- Calibration Activities
- Unit Alarms such as Open Door (tamper) if applicable, Transducer Failure, A/D Over Range, Power and Other Systems

5.4.8 The PLC System audit trail will maintain a record of a minimum of 50 events or activities before an upload reset, or if it is a circular file, the oldest entry is over written.

5.4.9 The PLC System Input/Output scan rate will be a maximum of 1 time per second.

5.5 RTU Systems

5.5.1 RTU System programming or configuring will be by one of the following:

- Local Keyboard
- Local using a PC-based system or via modem connection using a PC or SCADA System.
- PLC System programming software will allow access to and display selectable Analog or Digital inputs or outputs so that the system, including any connected devices such as pressure transmitters, temperature transmitter, meters, etc., can be inspected, calibrated or configured as a single unit.
- Local scroll and select switches (specialized applications)



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.5 RTU Systems (Cont'd)

5.5.2 The RTU System will have alarms that will trigger with a time and date stamp (where applicable) under the following conditions:

- Open Door/Tamper Alarm or Indicator if present
- Loss of Auxiliary Power
- Low Main and Memory Battery
- A/D Over/Under or Transducer Fail
- Software Malfunction
- High/Low Temperature, Pressure, Flow Rate

NOTE: Portions of this requirement may be waived for specialized Corrector/PLC applications

5.5.3 The RTU System will be capable of operating properly in all the various weather conditions occurring in SWG's service areas without damage to the unit including:

- Ambient Temperature Range of -20°F to 150°F (-28°C to 65.56°C)
- Humidity to 100 percent non-condensing

5.5.4 The RTU System will not be adversely affected by mechanical shock, vibration or electromagnetic radiation.

5.5.5 The RTU System display will default to pre-determined readouts within 30 minutes or a programmable interval to Corrected Volume Accumulation (EVC Application) or Primary Active Pressure (EPR Application).



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5. PERFORMANCE REQUIREMENTS (Cont'd)

5.5 RTU System (Cont'd)

5.5.6 The RTU Systems electronic security will have access codes for each mode of the units data and programming selection for the following:

- Alarm Reset
- Calibration
- Configuration
- Default Data Display Scroll Switch

NOTE: All or portions of this requirement may be waived by SWG for specialized applications.

5.5.7 The RTU System gas volume calculations will be based on the following American Gas Association (AGA) Reports:

- AGA #7 for Turbine Meters
- AGA #3 for Orifice Metering

And either:

- NX-19 or AGA #8 for Determining Super Compressibility Correction Factor.

5.5.8 The PLC System will provide the super compressibility calculation method as a selectable option.



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6. DIMENSIONS AND TOLERANCES

- 6.1 Transducer accuracy, linearity, hysteresis and repeatability as a total will be ± 0.25 percent or better for the full scale calibration range.
- 6.2 Pressure transducers will not be affected by more than + 0.005 percent of the calibrated range for a temperature change of $\pm 1^{\circ}\text{F}$ ($\pm 0.56^{\circ}\text{C}$)
- 6.3 Drift of pressure transducers will not exceed ± 0.25 percent of the full scale calibration range for 12 months.
- 6.4 Temperature transducers will have an accuracy of $\pm 0.2^{\circ}\text{F}$ ($\pm 0.11^{\circ}\text{C}$) for a calibrated temperature range of -20°F to 140°F (-28.89°C to 60°C).
- 6.5 Drift of temperature transducers will not exceed $\pm 0.2^{\circ}\text{F}$ ($\pm 0.11^{\circ}\text{C}$) of the full scale calibration range for 12 months.



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7. FACTORY PRESETS

7.1 EPR Systems

7.1.1 The EPR System will have the following item preset by the factory prior to shipment to the noted data value or condition:

- Display
 - Display Digits 6 Visible
- Scroll Display Sequence
 - Alarms
 - Pressure #1
 - Pressure #2, if used
 - Pressure #3, if used
 - Pressure #4, if used

NOTE: Variations in the sequence must be approved.

7.1.2 In addition to the above, all EPR Systems received from Mercury Instruments, Inc. must have the historical logs configured with the following values and sequence preset by the factory prior to shipment:

- Item # 589-Value of Item #500-Pressure 1
- Item #590-Value of Item #651-P1 Int Low
- Item #591-Value of Item #650-P1 Int High
- Item #592-Value of Item #649-P1 Int Average
- Item #593-Value of Item #501-Pressure 2
- Item #594-Value of Item #654-P2 Int Low
- Item #595-Value of Item #653-P2 Int High
- Item #596-Value of Item #652-P2 Int Average
- Item #597-Value of Item #420-P3 Gas Pressure (Voltage)
- Item #598-Value of Item #503-Case Temperature



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7. FACTORY PRESETS

7.1 EPR Systems (Cont'd)

7.1.3 In addition to the above, the following Mercury Item Numbers will have the listed values or conditions:

- Item #599-Value of 1 or Active
- Item #600-Value of 0 or Inactive
- Item #601-Value of 0 or Inactive
- Item #602-Value of 0 or Inactive
- Item #603-Value of 0 or Inactive
- Item #604-Value of 0 or Inactive

NOTE: Variations must be approved.

7.1.4 All other manufacturer's EPR Systems will be preset at the factory prior to shipment with the historical logs configured to SWG specified values and sequence.

7.2 EVC Systems

7.2.4 The EVC Systems will have the following items preset by the factory prior to shipment to the noted data value or condition:

- Base Conditions
 - Base Pressure 14.73 psia
 - Atmospheric Pressure 14.11 psia
 - Base Temperature 60°F
- Gas Quality
 - Specific Gravity 0.625
 - MOL% Nitrogen 1.2
 - MOL% Carbon Dioxide 0.9
 - MOL% Oxygen 00.00



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7. FACTORY PRESETS (Cont'd)

7.2 EVC Systems (Cont'd)

7.2.2 The EVC Systems will have the following items preset by the factory prior to shipment to the noted data value or condition:
(Cont'd)

- Scaling
 - Corrected Multiplier x1000 (Mcf)
 - Uncorrected Multiplier x100 (Ccf)

- Display & Index Masking
 - Corrected Vol Display Digits 6 Visible
 - Uncorrected Vol Display Digits 6 Visible

- Scroll Display Sequence
 - Corrected Volume
 - Uncorrected Volume
 - Meter Pressure
 - Gas Temperature
 - Battery Voltage*

*Display Voltage

NOTE: Variations must be approved.



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7. FACTORY PRESETS (Cont'd)

7.2 EVC Systems (Cont'd)

7.2.2 In addition to the above, all EVC Systems received from Mercury Instruments, Inc. must have the historical logs configured with the following values and sequences preset by the factory prior to shipment:

- Item #258-Value of Item #225-Incremental Cor Vol
- Item #259-Value of Item #226-Incremental Unc Vol
- Item # 260-Value of Item #206-PCor Average Pressure
- Item #261-Value of Item #207-Average Temperature
- Item #229-Value of Item #048-Battery Voltage Reading
- Item #230-Value of Item #000-Corrected Volume
- Item#231-Value of Item #002-Uncorrected Volume
- Item #232-Value of Item #210-Peak Flow Rate
- Item #233-Value of Item #214-PCor Interval HI Press
- Item #234-Value of Item #215-PCor Interval LO Press

NOTE: Variations must be approved.

7.2.3 In addition to the above, the following Mercury Item Numbers will have the listed values or conditions:

- Item #202-Value of 60 Minutes
- Item #205-Value of 00 00 00
- Item #235-Value of 1 or Active
- Item #236-Value of 0 or Inactive
- Item #237-Value of 0 or Inactive/No Alarm Records
- Item #238-Value of 0 or Inactive/No Serial Records
- Item #239-Value of 0 or Inactive
- Item #242-Value of 0 or Inactive

NOTE: Variations must be approved.



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7. FACTORY PRESETS (Cont'd)

7.2 EVC Systems (Cont'd)

7.2.4 All other manufacturer's EVC Systems will be preset at the factory prior to shipment with the historical logs configured to SWG specified values and sequence.

7.3 PLC Systems

7.3.1 PLC Systems will have the following preset at the factory prior to shipment to the noted value or condition:

- Base Conditions
 - Base Pressure 14.73 psia
 - Atmospheric Pressure 14.11 psia
 - Base Temperature 60°F

- Gas Quality
 - Specific Gravity 0.625
 - MOL % Nitrogen 1.2
 - MOL % Carbon Dioxide 0.9
 - MOL % Oxygen 00.00

- Scaling
 - Corrected Multiplier x1000 (Mcf)
 - Uncorrected Multiplier x100 (Ccf)



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7. FACTORY PRESETS (Cont'd)

7.3 PLC Systems (Cont'd)

7.3.2 PLC Systems will have the following preset at the factory prior to shipment to the noted value or condition: (Cont'd)

- Display, if present
 - Display Digits 6 visible

- Scroll Display Sequence, if present
 - Corrected Volume
 - Uncorrected Volume
 - Meter Pressure
 - Gas Temperature
 - Battery Voltage*

*Display Voltage

NOTE: Variations in the sequence must be approved.

7.3.3 All PLC Systems will be preset at the factory prior to shipment with the historical logs configured to SWG specified values and sequence.

7.3.4 Portions of preset requirements may be waived by SWG for specialized applications but all variations require prior approval from SWG Engineering Staff.



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8. INSPECTION

- 8.1 Successful review of the Product Information Package (PIP), as well as any future reference by SWG to the Seller's part number or internal code number in any future contract or purchase, will mean only that no conflict with the specification was found and will not relieve the Seller from meeting all the requirements of this specification.
- 8.2 SWG retains the option to inspect the manufacture and testing of any and all materials, products or systems referenced in this specification that are sold to SWG.
- 8.3 SWG will make the appropriate inspections and tests of any and all materials, products or systems supplied to this specification. SWG will have the right, at their option, to reject any material which fails to conform to this specification. Any such rejection may take place at the manufacturer's facility, the supplier's warehouse or any subsequent delivery location, before or after SWG assumes possession. Notice of the rejection will be made promptly to the supplier by SWG. The defective product will be replaced or returned for credit at the manufacturer's expense.
- 8.4 Any changes in the manufacturing of previously approved materials, products or systems described in this material specification for sale to SWG, must be approved by SWG's Engineering Staff. Failure to obtain SWG's approval may be caused for rejection and disqualification as an approved supplier.
- 8.5 A performance test will be completed on each EVCR System by the manufacturer to verify compliance with this specification. Acceptance of the manufacturer's test results by SWG will not relieve the Seller from meeting all the requirements of this specification.



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9. CERTIFICATION

The manufacturer's or supplier's certification will be furnished to SWG. This certification will state that samples representing each lot have been manufactured, tested and inspected in accordance with this specification and that all requirements have been met.

Upon the request of Southwest, the certification of an independent third party indicating conformance to the specification may be considered at Southwest's expense.

10. SAFETY DATA SHEETS

In accordance with law, the Seller will supply Safety Data Sheets for all applicable items supplied under this specification to the following:

- 1) The Receiving Location
- 2) Engineering Staff
- 3) Southwest Gas Corporation
Corporate Safety
Mail Station LVA-120
P.O. Box 98510
Las Vegas, NV 89193-8510

11. PRODUCT MARKING

11.1 Any part made of potentially hazardous material that may require special disposal when the part is replaced will be labeled by the manufacturer.

11.2 EVCR Systems will be marked with the following:

- Pressure Rating
- Temperature Rating
- Manufacturer's Name
- Serial Number
- Model Number
- Date of Manufacturer



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11. PRODUCT MARKING (Cont'd)

11.3 EVCR Systems will also provide the appropriate approvals and/or certifications from the following companies:

Underwriters Laboratories (UL)
Factory Mutual (FM)
Canadian Standards Authority (CSA)

12. PACKAGING AND PACKAGE MARKING

12.1 All EVCR Systems will be packaged in a manner to prevent damage during transportation and storage.

12.2 The following will be packaged with each EVCR System:

- Installation, operating and maintenance instructions
- Testing, calibration procedures
- Test results for each EVCR System



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13. STOCK CLASSIFICATION DESCRIPTION

13.1 CORRECTOR, VOLUME, ELECTRONIC (EVC), (CORRECTOR TYPE: PRESSURE, TEMPERATURE, PRESURE AND TEMPERATURE), (MANUFACTURER), (MODEL), (COMMUNICATIONS APPLICATION;STANDALONE, INTERNAL DIAL-UP, DATA LINK EXTENSION) (PSI RANGE _____ PSIG), (PRESSURE CONNECTION: ¼ OR ½ INCH NPT CONNECTION), TEMPERATURE PROBE ASSEMBLY ¼ X MINIMUM 6 INCH SS PROBE X 6 FOOT CABLE, (POWER SUPPLY: BATTERY & TUPE OR EXTERNAL) UNIVERSAL INDEX MOUNT, PULSE OUTPUT FOR CORRECTED AND UNCORRECTED VOLUMES, (UL, FM, CSA) LISTED CLASS 1, GROUP D, (DIVISION ½ INTRINSICALLY SAFE, OR DIVISION 2 NON-INCENDIVE), INSTALLATION KIT: MOUNTING BOLTS, GASKET, INDEX, MASKING KIT IF APPLICABLE, TEMPERATURE PROVE ADAPTOR (1/4 INCH TUBING TO ½ NPT) AND INSTALLATION MANUAL.

13.2 RECORDER, PRESSURE, ELECTRONIC (EPR), (RECORDER TYPE: PRESSURE ONLY, PRESSURE AND TEMPERATURE), (MANUFACTURER), (MODEL), (COMMUNICATIONS: APPLICATION: STANDALONE, INTERNAL DIAL-UP, DATALINK EXTENSION) PSI RANGE _____(PSIG), (PRESSURE ¼ or 1/2 Inch) CONNECTION, OPTIONAL TEMPERATURE PROBE ASSEMBLY ¼ X MINIMUM 6 INCH SS PROBE X 6 FOOT CABLE, (POWER SUPPLY: BATTERY & TYPE OR EXTERNAL), POLE/WALL MOUNT, (UL, FM, CSA) LISTED CLASS 1, GROUP D, (DIVISION ½ INTRINSICALLY SAFE OR DIVISION 2 NON-INCEDIVE), INSTALLATION KIT: MOUNTING HARDWARE, TEMPERATURE PROBE ADAPTOR (1/4 INCH TUBING TO ½ NPT) IF APPLICABLE AND INSTALLATION MANUAL.