

# ELECTRONIC GAS MEASUREMENT AUDITING

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Auditing electronic gas measurement information demands a thorough knowledge of both field and office measurement procedures and as much information from the primary, secondary and ancillary equipment as possible. Despite equipment advances in the electronic measurement field, today's auditor finds the demands of investigating electronic measurement differ little from auditing chart-based in the amount of raw information needed. Confirming accuracy or resolving discrepancies requires gathering as much information as possible.

**Chart-based.** For a chart-based system, the audit often begins with a request for the raw data, the charts, to be sent to an auditor. The auditor needs the charts, not just volume statements, to produce audit volume statements. All supporting documents are also requested, including field meter inspection reports, orifice change reports and gas analysis reports.

The auditor reviews these reports and inputs the information supplied from them into a volume program. The charts will be processed and entered into the volume program and an audit volume statement will be generated. If the audit volume statements agree with the original volume statements, then it is likely that the chart processing function and volume calculation program did not the cause the metering difference. At this point, if not already addressed, a field audit or lab audit will likely ensue.

**Electronic Gas Measurement.** The old adage, "the more things change, the more they remain the same" applies to electronic gas measurement (EGM) auditing. For volumes produced by electronic metering equipment, the auditor needs raw data to properly perform the audit. All supporting documents are required as with the chart audit. From this point the process will vary slightly. It is necessary to obtain the raw data from the electronic flow recorder in an encrypted format to maintain the audit trail. At all points through the audit process this audit trail must be kept intact or the audit is of no merit. All editing transactions must be recorded with the reason for the edit and person responsible. With a chart, one can visually inspect a graph of the raw data. The chart itself is a picture of the flow data and can often reveal the source and/or time of the error.

The person responsible for censoring the charts will give instruction to the integrator operator when it is necessary to correct for these errors.

In EGM auditing, the task becomes easier if a graph of the flow data is produced. When an associated editing function is provided, we refer to this as a graphical editor. Graphical editing of the data is not required in EGM auditing, but definitely is desirable.

Trending and statistical comparison of the data is another tool to aid the audit process. The data is analyzed by statistical means and outlier values flagged. These flagged values are then investigated to determine validity. If statistical limits are not properly assigned to a given meter, then it will be more of a detriment than an asset in the process. Flow data, alarm and event records are correlated to determine possible errors. To perform the audit certain items are needed:

- Raw data files
- Edited data files
- Meter inspection reports
- Gas analysis reports
- A copy of the contract sections relevant to measurement
- Any other documentation pertinent to the station

Nice to have information includes flow schematics and facility design drawings that can provide additional information. Data from check meters or check recorders also can be useful. It is difficult to obtain too much information to properly perform the audit. The EGM audit process can be divided into two categories:

- Data editing
- Data auditing.

It is an editing function if the information is being reviewed to correct for problems on a routine basis for the owner of the meter stations.

It is an audit function if the information is being reviewed for another party's meter stations to reconcile discrepancies or one's own meter stations for verification by a third party.

EGM editing can reduce the amount of edits in the audit process if it is done properly. The auditor needs to become familiar with the processes involved in the measurement data flow. It is important to understand:

- Manufacturer's software and hardware
- Policies and procedures of the owner of the metering facilities

- Policies and procedures used by any other party involved in generating the data.

**Error causes.** Causes of measurement errors can be divided into about five categories:

- Operational and facility design
- Primary measurement elements
- Secondary measurement elements
- Analytical data
- Personnel induced errors

While all of these do not directly involve the EGM, they all affect the overall measurement accuracy and calculated volumes produced by the EGM.

Operational and facility design problems are the conditions produced by equipment other than the meter station. Improperly set separator dumps can allow liquid carry-over into the gas meter run. Fluid in the meter run, gauge lines or meter manifold will produce unreliable calculated volumes. Hydrate formation causes meter freeze-ups, which result in erroneous volumes. Reciprocating compressors can produce pulsation, which affects measurement accuracy. Upstream piping and valves can produce swirl and velocity flow profile distortions, which, if not corrected in the metering facility, will affect measurement accuracy. It is very important to be aware of the existence of these conditions and, if possible, to correct them.

Primary device errors can produce large, incorrect volumes. Meter tubes, straightening vanes or flow conditioners, seal rings and orifice plates should be checked to confirm API 14.3 compliance.

It is common to check the orifice plate at the time of meter calibration. If the frequency of calibration is reduced due to the reliability and stability of the EGM the orifice inspection should be maintained on a more frequent basis.

The meter tube and straightening vanes or flow conditioner are not easily inspected. This is usually done as a last resort since it requires flow shut down in most cases. If there is a bypass on the meter run, it is not uncommon for one of the valves to leak and allow some of the gas to go unmeasured. The same is true of cut seal rings. If a check valve is leaking, there can be reverse flow, which, due to low differential cutoff, will be calculated as no flow. These conditions must be verified in the field to assist the audit process. A check meter, if it complies with API 14.3 standards, is an invaluable tool in determining the amount of adjustment when there is a primary measurement error.

The secondary device, or recorder, whether chart or electronic, can fail. Transducers can produce erroneous results when they fail. Failed boards, charging systems and batteries can cause lost data. When the EGM fails, a check recorder or meter can provide data to correct the unmeasured or mismeasured volumes.

Misapplied or miscalculated analytical data must be corrected for. If the data is not supplied from an on-stream analyzer, then the effective date for the analysis should be applied for the period in which it was collected, or per the contract. Analytical data in the EGM device should be verified with the analysis report. The analytical data not only affect the energy calculation, but also the gravity and supercompressibility factors. On-stream analyzer data should undergo statistical QA/QC similar to that of the flow data. If there is a discrepancy between analytical data and check analyses, it may be necessary to audit the on-stream analyzer or the laboratory supplying the analyses.

The problems produced by personnel can be further subdivided into two classes: field and office.

Field personnel introduce errors at initial setup, during routine inspections and during plate verifications or plate changes. At initial setup, the EGM configuration and audit trail can be compromised by incorrect entries and incorrect sequences. When the EGM station is inspected, care must be taken to maintain the audit trail. The meter inputs should be locked in prior to testing and plate inspection. The test equipment must be in good calibration and operating condition. If leaks are present in the test equipment or meter manifold, the calibration process is invalid. When the test is concluded, the meter's frozen inputs should be released. The manifold should be put back in service. When the plate is changed, care must be taken to ensure that the volumes will be calculated on the size plate that is in the run. Not only must the configuration be updated, but in some cases, the volume must also be reset. A key function of field personnel is to communicate problems and potential problems to office personnel for evaluation and remediation.

**Good listening skills.** One of the most important functions of office personnel is to listen to and evaluate communications from the field. Failure to correct reported problems could prolong facility design and operational problems. Office personnel can also upload incorrect information to the EGM.

Once data has arrived at the office, it must be handled properly to produce accurate gas volumes. It is not uncommon for valid data to erroneously be assumed bad and therefore deleted and for bad data to be used to produce invalid volumes.

The EGM calculates based on live inputs every second, accumulates the volumes and typically reports hourly. The inputs reported are average values for the reporting increment. Recalculation uses these average values, and some degree of error results.

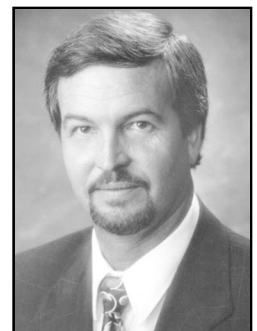
A good EGM editing package will partially compensate for or estimate the recalculation error. The editing package must be able to use both AGA-3 1985 and 1992 volume calculations and either NX-19, AGA-8 Detail,

AGA-8 Gross 1, or AGA-8 Gross 2 supercompressibility calculations. The audit trail must be maintained throughout the process of scrubbing and editing the data.

The auditor/editor must collect and assimilate all of the data provided. It may be necessary to request other sources of data, field or lab inspections and personnel interviews, to try to fill the gaps. This is why it is important

that the personnel responsible for the EGM auditing/editing functions are knowledgeable in both field and office gas measurement procedures.

Finally, it is very important that the editing software package provides the necessary tools to automate and expedite the process, maintains the integrity of the audit trail and complies with API 21.1.



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