

Conditions of Approval for Coriolis Meters

A. General requirements and components

1. A Coriolis meter must be proven at the frequency and under the requirements of Onshore Order 4, Section III.D.3
2. At the beginning of every month the operator, purchaser, or transporter, as appropriate, must complete a uniquely numbered measurement ticket, in either paper or electronic format, with the following information:
 - a. Lease, unit PA, or CA number;
 - b. Unique meter ID number;
 - c. Opening and closing dates;
 - d. Opening and closing totalizer readings of the indicated volume;
 - e. Meter factor, indicating if it is a composite meter factor;
 - f. Total gross standard volume removed through the Coriolis meter;
 - g. API oil gravity:
 - (i) If the API oil gravity is determined from a composite sample, the observed API oil gravity, the temperature indicated in °F, and the API oil gravity corrected to 60 °F.
 - (ii) For API oil gravity determined by the Coriolis meter, the average density between the opening and closing dates, expressed in API units;
 - h. The average temperature in °F;
 - i. The average flowing pressure in psig;
 - j. S&W content percent;
 - k. Unique number of each seal removed and installed;
 - l. Name of the purchaser's representative; and
 - m. Name of the operator.
3. Any accumulators used in the determination of average pressure, average temperature, and average density must be reset to zero whenever a new measurement ticket is opened.
4. The Coriolis meter must be installed with the components listed in API 5.6 with the following additional requirements:
 - a. The system must have a pressure-indicating device downstream of the meter, but upstream of meter-proving connections. The pressure-indicating device must be capable of providing pressure data to calculate the CPL correction factor.
 - b. An electronic temperature averaging device must be installed, operated, and maintained as follows:
 - (i) The temperature sensor must be placed in compliance with API 7;
 - (ii) The electronic temperature averaging device must be volume weighted and take a temperature reading following API 21.2, Subsection 9.2.8;
 - (iii) The average temperature for the measurement ticket must be calculated by the volumetric averaging method using API 21.2, Subsection 9.2.13.2a (incorporated by reference, see § 3174.3);
 - (iv) The temperature averaging device must have a reference accuracy of ± 0.5 °F or better, and have a minimum graduation of 0.1 °F;
 - (v) The temperature averaging device must include a display of instantaneous temperature and the average temperature calculated since the measurement ticket was opened; and
 - (vi) The average temperature calculated since the measurement ticket was opened must be used to calculate the CTL correction factor.

- c. If nonzero sediment and water (S&W) content is to be used in determining net oil volume, the sampling system must meet the requirements of Onshore Order 4, Section III.C.7. If no sampling system is used, or the sampling system does not meet the requirements of Onshore Order 4, Section III.C.7, the S&W content must be reported as zero.
 - d. Sufficient back pressure must be applied to ensure single phase flow through the meter.
5. *Determination of API oil gravity.* The API oil gravity reported for the measurement ticket period must be determined by one of the following methods:
 - a. Determined from a composite sample taken pursuant to Onshore Order 4, Section III.C.5; or
 - b. Calculated from the average density as measured by the Coriolis meter over the measurement ticket period under API 21.2, Subsection 9.2.13.2a. Density must be corrected to base temperature and pressure using API 11.1 or Table 5A.
6. *Determination of net standard volume.* Calculate the net standard volume at the close of each measurement ticket following the guidelines in API 12.2.1 and API 12.2.2.

B. Operating requirements

1. *Minimum electronic pulse level.* The Coriolis meter must register the volume of oil passing through the meter as determined by a system that constantly emits electronic pulse signals representing the indicated volume measured. The pulse per unit volume must be set at a minimum of 8,400 pulses per barrel.
2. *Meter specifications.*
 - a. The Coriolis meter specifications must identify the make and model of the Coriolis meter to which they apply and must include the following:
 - (i) The reference accuracy for both mass flow rate and density, stated in either percent of reading, percent of full scale, or units of measure;
 - (ii) The effect of changes in temperature and pressure on both mass flow and fluid density readings, and the effect of flow rate on density readings. These specifications must be stated in percent of reading, percent of full scale, or units of measure over a stated amount of change in temperature, pressure, or flow rate (*e.g.*, “ ± 0.1 percent of reading per 20 psi”);
 - (iii) The stability of the zero reading for volumetric flow rate. The specifications must be stated in percent of reading, percent of full scale, or units of measure;
 - (iv) Design limits for flow rate and pressure; and
 - (v) Pressure drop through the meter as a function of flow rate and fluid viscosity.
 - b. Submission of meter specifications: The operator must submit Coriolis meter specifications to the BLM upon request.
3. *Non-resettable totalizer.* The Coriolis meter must have a non-resettable internal totalizer for indicated volume.
4. *Verification of meter zero value using the manufacturer’s specifications.* If the indicated flow rate is within the manufacturer’s specifications for zero stability, no adjustments are required. If the indicated flow rate is outside the manufacturer’s specification for zero stability, the meter’s zero reading must be adjusted. After the meter’s zero has been adjusted, the meter must be proven as required by Onshore Order 4, Section III.D.3. A copy of the zero value verification procedure must be made available to the Authorized Officer (AO) upon request.

5. *Required on-site information.*
 - a. The Coriolis meter display must be readable without using data collection units, laptop computers, or any special equipment, and must be on-site and accessible to the AO.
 - b. For each Coriolis meter, the following values and corresponding units of measurement must be displayed:
 - (i) The instantaneous density of liquid (pounds/bbl, pounds/gal, or degrees API);
 - (ii) The instantaneous indicated volumetric flow rate through the meter (bbl/day);
 - (iii) The meter factor;
 - (iv) The instantaneous pressure (psi);
 - (v) The instantaneous temperature (°F);
 - (vi) The cumulative gross standard volume through the meter (nonresettable totalizer) (bbl); and
 - (vii) The previous day's gross standard volume through the meter (bbl).
 - c. The following information must be correct, be maintained in a legible condition, and be accessible to the AO at the FMP without the use of data collection equipment, laptop computers, or any special equipment:
 - (i) The make, model, and size of each sensor; and
 - (ii) The make, range, calibrated span, and model of the pressure and temperature transducer used to determine gross standard volume.
 - d. A log must be maintained of all meter factors, zero verifications, and zero adjustments. For zero adjustments, the log must include the zero value before adjustment and the zero value after adjustment. The log must be made available upon request.
6. *Audit trail requirements.* Audit trail requirements must follow API 21.2, Subsection 10. All data must be available and submitted to the BLM upon request.
 - a. *Quantity transaction record (QTR).* Follow the requirements for a measurement ticket in Paragraph A.2 of these COAs.
 - b. *Configuration log.* The configuration log must comply with the requirements of API 21.2, Subsection 10.2. The configuration log must contain and identify all constant flow parameters used in generating the QTR.
 - c. *Event log.* The event log must comply with the requirements of API 21.2, Subsection 10.6. In addition, the event log must be of sufficient capacity to record all events for 7 years or the life of the meter, whichever is shorter.
 - d. *Alarm log.* The type and duration of any of the following alarm conditions must be recorded:
 - (i) Density deviations from acceptable parameters; and
 - (ii) Instances in which the flow rate exceeded the manufacturer's maximum recommended flow rate or was below the manufacturer's minimum recommended flow rate.
7. *Data protection.* Each Coriolis meter must have installed and maintained in an operable condition a backup power supply or a nonvolatile memory capable of retaining all data in the unit's memory to ensure that the audit trail information required under Paragraph B.6 of these COAs is protected.