

### Electric Watthour Meters

Device Description: \_\_\_\_\_

Contact Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Company: \_\_\_\_\_ Address: \_\_\_\_\_

E-mail: \_\_\_\_\_ City: \_\_\_\_\_

#### Instructions For Completing Pre-Evaluation Checklists

You will need to complete **both** the "General" checklist and this "Electric Watthour Meters" checklist when submitting an electric watthour metering system application.

These checklists include requirements extracted from the California Code of Regulations. Though not all-encompassing, the checklists contain requirements beyond those which would apply to any single device type or accessory. It is best to think of a device type as a weighing or measuring device system or as a component of such a system whichever best describes the device(s).

When applying the requirements to your device you have three options; Check

- YES** If your device or system complies
- NO** If the device or system does not comply
- NA** If sections appear not to apply to the device or system type(s)

If selecting "**NO**", consider if your device or system is ready for evaluation. If the deficiency is of such a nature that it will not effect the ability to test for accuracy, such as failure to conform with marking requirements or lack of provision for sealing, the evaluation can probably begin while deficiencies are being corrected.

*If you are not able to conduct accuracy testing your system or device is probably not yet ready for an evaluation.*

---

I have reviewed the enclosed specifications, tolerances, and test notes for the device type for which we have applied for evaluation and approval. To the best of my knowledge I have determined the device meets all applicable requirements.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

### Electric Watthour Meters

<p><b>4027. A. Application.</b></p> <p><b>A.1.</b> This code applies to electronic and mechanical electric energy submeters used for “commercial purposes”.</p> <p><b>A.2.</b> See also National Institute of Standards and Technology (NIST) Handbook 44, Section 1.10, General Code requirements adopted in Article 1, Chapter 1, Sections 4000, 4001, and 4002.</p> <p><b>A.3.</b> This code does not apply to the use of any weight or measure or weighing or measuring instrument used by a public utility in connection with measuring gas, electricity, water, steam, or communication service subject to the jurisdiction of the Public Utilities Commission.</p> <p><b>A.4.</b> Code sections and subsections with an (EM) notation apply to electronic meters only. Code sections and subsections with a (MM) notation apply to mechanical meters only. Code sections and subsections without (EM) or (MM) notation apply to both meter types.</p>			
	<b>Yes</b>	<b>No</b>	<b>NA</b>
<p><b>4027.2. S. Specifications.</b></p>			
<p><b>S.1. Metrological Components.</b> A meter system shall be designed and constructed so that metrological components are adequately protected from environmental conditions likely to be detrimental to accuracy.</p>			
<p>Components shall be designed to prevent undetected access to adjustment mechanisms and terminal blocks by providing for application of a physical security seal or an Audit Trail.</p>			
<p><b>S.2. Terminals.</b> - The terminals of the meter shall be arranged so that the possibility of short circuits in removing or replacing the cover, making connections and adjusting the meter is minimized.</p>			
<p><b>S.3. Provision for Sealing.</b></p> <p><b>S.3.1. Sealing.</b> Provisions shall be made for applying a security seal in a manner that requires the seal to be broken, or for other approved means of providing security (e.g. audit trail available at the time of inspection), before an adjustment can be made that affects the metrological integrity of the meter. The audit trail shall use the format set forth in Table S.3.1.</p> <p><i>Category 1:</i> No remote configuration capability.</p> <p><i>Category 2:</i> Remote configuration capability, but access is controlled by physical hardware. The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p> <p><i>Category 3:</i> Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password). The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</p>			
<p><b>S.4. Meter Identification and Marking Requirements.</b> The following identification and marking requirements are in addition to the requirements of National Institute of Standards and Technology (NIST) Handbook 44, Section 1.10, General Code, G-S.1. Each meter shall have the following information legibly marked on the nameplate or register, if applicable.</p>			

**Electric Watthour Meters**

	Yes	No	NA
<p><b>S.4. Meter Identification and Marking Requirements.(Continued)</b></p> <p>(a) Manufacturer's name or trademark, type designation, and non-repetitive serial number.                      (b) AC voltage rating.                      (c) Test amperes (TA).                      (d) Meter class (CL).                      (e) Watthour or rotor constant (K<sub>h</sub>).                      (f) (MM) Register ratio (R<sub>r</sub>) and multiplier (if greater than one).                      (g) Frequency rating (Hz).                      (h) Number of meter stator(s) or element(s).                      (i) Watthour meter or other descriptive term.                      (j) (MM) Number of wires (W).                      (k) (MM) Form designation (FM).                      (l) (EM) Watthour test constant (K<sub>t</sub>).</p> <p>Instrument transformer-rated meters shall contain the following additional information:</p> <p>(m) Instrument transformer ratio or transformer model number.                      (n) (MM) Primary watthour constant (PK<sub>h</sub>).                      (o) Temperature Limits, if narrower than and within -20°C to +50°C (-4°F to 122°F).                      (Nonretroactive as of February 12, 2009)</p>			
<p><b>S.5. Abbreviations and Symbols.</b> The following abbreviations or symbols may appear on a meter, instrument transformer, or indicator.</p> <p>(a) FM = Form                      (b) CL = Class                      (c) V = Volts                      (d) Hz = Hertz, Frequency or Cycles Per Second                      (e) TA = Test Amperes                      (f) Kh = Watthour Constant Per Rotor Revolution or Pulse                      (g) PKh = Primary Watthour Constant                      (h) Rr = Register Ratio                      (i) CTR = Current Transformer Ratio                      (j) VTR or PTR = Voltage or Potential Transformer Ratio                      (k) MULT BY = Multiply By                      (l) W = Wire (example: 240V 3W)                      (m) Y = WYE Power Supply                      (n) ANSI = American National Standards Institute                      (o) B = Burden                      (p) BIL = Basic Lightning Impulse Insulation Factor                      (q) Kt = (EM) Watthour Test Constant                      (r) AC = Alternating Current (i.e. VAC)                      (s) Wh = Watthour                      (t) kWh = Kilowatthour                      (u) Δ = Delta Power Supply</p>			

**Electric Watthour Meters**

	Yes	No	NA
<p><b>S.6. Instrument Transformer.</b></p> <p><b>S.6.1. Identification.</b> Each instrument transformer that is non-integral with the meter shall have a permanent identification label identifying the following:                      (a) Manufacturer's name, type designation, and non-repetitive serial number                      (b) True ratio, primary versus secondary, ampere or voltage values                      (c) Accuracy class                      (d) Burden designation (B)                      (e) Basic lightning impulse insulation level (BIL)                      (f) Rated Frequency (HZ)</p> <p><i>Note:</i> If evident by the method of integration that instrument transformers are not intended to be detachable or replaceable, the required information may be located on the meter. (Nonretroactive as of February 12, 2009)</p> <p><b>S.6.2. Accuracy Class.</b> An instrument transformer that is not an integral part of the meter and is used for revenue metering shall be rated 0.3 accuracy class or more accurate for the burden of a particular meter type. If a meter system requires an instrument transformer more accurate than 0.3 accuracy class, the limitations shall be stated on the meter. (Nonretroactive as of February 12, 2009)</p> <p><b>S.6.3. Polarity Marking.</b> A permanent mark indicating proper installation orientation is required on the instrument transformer when the accuracy of the meter is affected</p>			
<p><b>S.7. (MM) Meter Register.</b> A meter register shall clearly indicate the number of kilowatthours measured by the meter. The register ratio shall be indicated on the front of the registers that are not an integral part of the meter nameplate. Means shall be provided for the tenant to read the meter register.</p>			
<p><b>S.8. (EM) Meter Watthour Display.</b></p> <p><b>S.8.1.</b> All submeters in a service system shall have an individual customer display on or at the meter and the minimum value shall not exceed one kilowatt hour. (Nonretroactive as of February 12, 2009)</p> <p><b>S.8.2.</b> All submeter systems shall be capable of displaying at least one watthour test constant (Kt) output indication but not more than 20 watthour test constant output indications. Means for displaying watthour test constant output indications include but are not limited to: decimal point, contrasting display colors, shorting link, or a means for visual flashing pulse counts. (Nonretroactive as of February 12, 2009)</p> <p><b>S.8.3.</b> The minimum display value (unit of measure) shall be conspicuously identified on or near the customer display. (Nonretroactive as of February 12, 2009)</p> <p><b>S.8.4.</b> A segmented digital display shall have an easily accessible provision for checking that all segments are operational. (Nonretroactive as of February 12, 2009)</p> <p><b>S.8.5.</b> If the display is not on continuously, it shall be accumulated continuously so that real-time measurement is displayed during activation. (Nonretroactive as of February 12, 2009)</p>			

**Electric Watthour Meters**

	Yes	No	NA
<p><b>S.9. Multiple Meter Indicating Elements.</b> An indicating or combination indicating-recording element coupled to two or more meter systems shall be provided with means to prohibit display of information from any meter system not selected, and shall be provided with automatic means to indicate clearly and definitely which meter system is associated with the indication.</p>			
<p><b>S.10. (EM) Meter-Control Program.</b> The meter-control program shall be an integral part of the meter's firmware read-only memory that cannot be changed in its operating environment. This section does not apply to electronic meters that do not utilize a meter-control program.</p>			
<p><b>S.11. (EM) Data Storage and Retrieval.</b>                      (a) Watthour data accumulated and displayed on the indicator shall be permanent and accessible.                      (b) Values displayed or stored in memory shall not be affected by electrical, mechanical or temperature variations, radio-frequency interference, power failure, or any other environmental influences to the extent that accuracy is impaired.                      (c) Memory and/or display shall be recallable for the life of the meter. A replaceable battery shall not be used for this purpose.</p>			
<p><b>S.12. Temperature Range for Metering Components.</b> Meters shall be accurate and correct over the temperature range of -20 °C to +50 °C (-4 °F to 122 °F). If the meter and/or components are not capable of meeting these requirements the installations shall be limited to temperature limits stated on the meter. (Nonretroactive as of February 12, 2009)</p>			
<p><b>4027.3. N. Notes.</b></p>			
<p><b>N.1. Meter Creep Test.</b> A meter creep test shall be conducted by applying rated voltage to the meter under test and no load applied.</p>			
<p><b>N.2. Meter Starting Load.</b> A meter starting load test shall be conducted by applying rated voltage and 0.5-ampere load.</p>			
<p><b>N.3. (MM) Test Revolutions.</b> Full and light load tests shall require 8 or more revolutions of the test standard and at least one revolution of the meter under test.</p>			
<p><b>N.4. (EM) Meter Test Constant Output Indications.</b> Full and light load tests shall consist of 8 or more watthour test constant (<math>K_t</math>) output indications of the test standard and at least one watthour test constant (<math>K_t</math>) output indication of the meter under test. Test standards that read out directly in watthours shall meet the watthour equivalent of 8 or more watthour test constant (<math>K_t</math>) output indications.</p>			
<p><b>N.5. Meter and System Test Loads.</b>                      (a) (MM) Mechanical self-contained meters shall be balanced load tested, and may be single element tested, for meter accuracy at full and light loads.                      (b) (MM) Instrument transformer rated systems shall be single element tested, and may be balanced load tested, for system accuracy at full and light loads. Meter testing shall be accomplished by applying the test load to the current transformer(s).                      (c) (EM) Instrument transformer(s) rated systems shall be single element tested, for system accuracy at full and light loads. Meter testing shall be accomplished by applying the test load to the instrument transformer(s) with the voltage circuits energized.                      (d) The reference voltage phases (A, B, or C) at the meter shall be the same phase as the load.</p>			

**Electric Watthour Meters**

	Yes	No	NA
<p><b>N.6. Test of a Meter System.</b>                      (a) Each meter submitted for test shall be a complete system. For example: a meter body and any necessary instrument transformer(s), indicator(s), system software, etc., required to make up a complete system.                      (b) The test load applied for a full load test shall be the marked test amperes (TA) on the nameplate of the meter under test.                      (c) The test load applied for a light load test shall be conducted at not less than 10% of the marked (TA) test amperes on the nameplate of the meter under test.                      (d) The test load applied for a full load test of a meter for a 0.5 power factor setting shall be the marked (TA) test amperes of the nameplate of the meter under test.                      (e) The test load applied for a light load test of a meter for a 0.5 power factor setting shall be conducted at not less than 20% of the (TA) test amperes of the meter.                      (f) All tests shall be made at the rated voltage <math>\pm 10\%</math>.                      NOTE: Authority cited: Sections 12027 and 12107, Business and Professions Code.                      Reference: Section 12107, Business and Professions Code.</p>			
<p><b>4027.4. T. Tolerances.</b></p> <p><b>T.1. Meters with Separate Components.</b> Where instrument transformers or other components are used, the provisions of this section shall apply to all metering components.</p>			
<p><b>T.2. Meter Creep Test.</b></p> <p><b>T.2.1. (EM)</b> The meter indicator or display shall not change by more than one least significant digit with the voltage circuit(s) energized and current circuit(s) not energized for a duration of one hour using the watthour test constant (<math>K_t</math>) output indications.</p> <p><b>T.2.2. (MM)</b> A meter rotor shall rotate no more than one complete revolution in 10 minutes with the meter voltage circuit(s) energized and the current circuit(s) not energized.</p>			
<p><b>T.3. Meter Starting Load Test.</b></p> <p><b>T.3.1. (EM)</b> The watthour test constant (<math>K_t</math>) output indication shall continue to advance when a load of 0.5 amperes is applied.</p> <p><b>T.3.2. (MM)</b> The meter rotor shall rotate continuously when a load of 0.5 amperes is applied.</p>			

**Electric Watthour Meters**

	Yes	No	NA
<p><b>T.4. Application to Underregistration and to Overregistration.</b> The following prescribed tolerances shall be applied to errors of underregistration and errors of overregistration.</p> <p><b>T.4.1. Tolerance Values.</b> Maintenance and acceptance tolerances for electric watthour meters shall be as follows for full and light load tests:                      (a) Maintenance tolerance shall be 2 percent for full and light loads.                      (b) Acceptance tolerance shall be 1 percent for full and light loads.</p> <p><b>T.4.2. Power Factor Tests.</b> Power factor tests shall be conducted at 0.5 power factor setting:                      (a) Maintenance tolerance shall be 2 percent for full and light loads.                      (b) Acceptance tolerance shall be 1 percent for full and light loads.</p> <p><i>NOTE:</i> 0.5 power factor light load tests shall be conducted at 20 percent of the Test Amperes (TA).</p> <p><i>NOTE:</i> Authority cited: Sections 12027 and 12107, Business and Professions Code.                      Reference: Section 12107, Business and Professions Code.</p> <p>The tolerance is in percent error. (see below)</p> <p><i>Step 1</i></p> $\text{Percent Registration} = \frac{\text{Wh measured by meter}}{\text{Wh measured by standard}} \times 100$ <p><i>Step 2</i>                      Percent Error.  <b>Percent Error = Percent Registration - 100</b></p>			