

DOCUMENT ED/R01/005

CUSTOMER METERING REGULATIONS

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CUSTOMER METERING REGULATIONS

The Regulation and Supervision Bureau for the Water and Electricity Sector in the Emirate of Abu Dhabi in exercise of its powers conferred under Article (62) of Law No (2) of 1998 Concerning the Regulation of the Water and Electricity Sector in the Emirate of Abu Dhabi, after consultation with the Abu Dhabi Water and Electricity Authority, **hereby makes the following Regulations:**

Part 1 GENERAL

1.1 Introduction

- 1.1.1 These Regulations may be cited as the Customer Metering Regulations and shall come into force on 1st July 2005.
- 1.1.2 The sale of electricity through electricity meters needs to be subject to practices that ensure fairness and equity for both the customer and the supplier. Both parties must understand their rights and responsibilities. Meters and their installation must be practical and where appropriate, consistent with international standards.
- 1.1.3 Words and expressions, other than those defined in paragraph 1.2 above, which are defined in the Law shall have the meanings ascribed to them in the Law.
- 1.1.4 Words and expressions to which meanings are assigned by these Regulations shall (unless the contrary intention appears) have the same respective meanings in any document issued by the Bureau under these Regulations.
- 1.1.5 Unless the context otherwise require, any reference in these Regulations to a numbered Part, paragraph or Schedule is a reference to the Part, paragraph or Schedule of these Regulations bearing that number.

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1.2 Definitions

- 1.2.1 The following words and expressions shall have the following meanings in these Regulations unless the context otherwise requires;

"Accredited Laboratory": a testing facility accredited to ISO/IEC 17025 or equivalent - general requirements for the competence of testing and calibration laboratories or any other laboratory approved by the Bureau.

"Authorised Manufacturer": any company who manufactures meters that can demonstrate that he has available to him appropriate apparatus for testing meters which complies with these regulations and operates a quality assurance system which conforms to ISO 9002 or equivalent.

"Authorised Repairer": any company who repairs meters and can demonstrate that he has available to him appropriate apparatus for testing meters which complies with these regulations and operates a quality assurance system which conforms to ISO 9002 or equivalent.

"Bureau": the Regulation and Supervision Bureau for the Water and Electricity Sector in the Emirate of Abu Dhabi.

"Certification": the process whereby a meter, following manufacture or refurbishment, is tested in an accredited laboratory, prior to installation, and is deemed to meet the accuracy requirements of the current Regulations or IEC standard which has been specified (which ever is the most strict).

"Certification life": the period which a meter used for billing purposes can remain in service without being laboratory tested. This period is defined for each type of meter and is based upon ongoing sample testing.

"Class Index": number which gives the permissible percentage error for all values of load current from $10\%I_b/I_n$ to I_{max} .

"Cold Water Meter": A self contained measuring instrument intended to measure continuously, memorize and display the volume of water passing through it. The measuring system employs either;

- A mechanical process where the use of volumetric chambers or the action of the water on the rotation rate of a moving part (turbine, impeller), or,
- An electronic process to transform the flow or the volume of the water to be measured into a signal suitable for display or transmission.

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"Customer": a person to whom water and electricity is supplied for a purpose mentioned in paragraph 2.1.

"Distribution Company": an entity licensed by the Bureau under the Law to distribute and/or supply water and electricity to premises.

"Electricity Meter": for the purposes of this definition it is a self contained measuring instrument intended to measure active and/or reactive energy by integrating active and/or reactive power with respect to time.

"Measuring System": a combination of meter test bench and working standards, used for the testing of electricity meters or cold water meters.

"Internationally recognised laboratory": an accredited laboratory, used by international regulatory authorities, to establish suitability, through 'Type Approval', meters for billing purposes. Also maybe certified/accredited for the calibration of Reference and Transfer standards, etc.

"Law": Law No (2) of 1998 Concerning the Regulation of the Water and Electricity Sector in the Emirate of Abu Dhabi.

"Nominal Flow-rate (Q_n)": is the flow-rate in cubic metres or imperial gallons per hour which is used to designate the meter, being equal to half the maximum flow-rate (Q_{max}).

"Maximum Flow-rate (Q_{max})": is the highest flow-rate at which the meter can function over limited periods without damage, without exceeding the prescribed limits of error on passing as fit for use for trade and without exceeding the value for pressure loss stated in the certificate of approval.

"Minimum Flow-rate (Q_{min})": is the flow-rate fixed as a function of the nominal flow-rate (Q_n) and above which the meter does not exceed the prescribed limits of error on passing as fit for use for trade.

"Meter Test Bench": a test facility capable of supplying controllable voltages, currents and water to meters under test.

"Metering Equipment": means water meters, electricity meters, measurement transformers, communications equipment and data collection/outstation equipment plus associated wiring.

"Manufacturers/Repairers Mark": a mark uniquely identified to the particular Manufacturer or Agent of a meter to which these Regulations apply, which identifies all or any of the following;

- The manufacturer of the meter,

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- The place and date of manufacture,
- The group of meters of which the meter forms part.

"Maximum Current (I_{max})": is the highest value of current at which the meter purports to meet the prescribed limits of error on passing as fit for use for trade.

"Minimum Current (I_b/I_n)": is the current in accordance with which the relevant performance of a direct or transformer connected meter is fixed and above which the meter does not exceed the prescribed limits of error on passing as fit for trade.

"Quality System": the organisational structure, responsibilities, activities, resources and events that together provide organised procedures and methods of implementation to ensure the capability of the organisation to meet quality requirements, such systems having been assessed as meeting the requirements of ISO 9001: 2000 or ISO 9002 by a suitably accredited independent certification body.

"Re-cycled Meter": a meter that has been taken out of service (for any reason) and is; maintained, tested, calibrated and re-certified for use under these Regulations.

"Reference Meter": a meter for use in testing measuring equipment and shall have been tested by a reference standard over the range of energy values or flow rates for which it is intended to be used.

"Reference Standard": an ac or dc standard whose measurement traceability to national standards is maintained by periodic calibration at a suitably accredited laboratory and is the standard against which working standards are directly or indirectly maintained.

"Transitional Flow-rate (Q_t)": is the flow rate fixed as a function of the nominal flow rate (Q_n) and at which the prescribed limits of error on passing as fit for use for trade change from 2 % to 5 %.

"Transfer Standard": a standard that has been verified by comparison to a reference standard and is used to compare working standards indirectly against reference standards.

"Type approved": a meter type which has been tested by an impartial, recognised, accredited agency on behalf of a regulatory body such as Ofgem (in the UK) and verified that meters are compliant with certain metrological standards. A certificate of approval is then issued.

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"Working Standard": a standard that has been verified by comparison to a reference standard or to a transfer standard and is used for the regulating and testing of electricity meters. Test equipment used for on-site meter testing and dispute resolution are deemed 'working standards'.

"Verification Scale": means the fastest-moving visible graduated element of the indicating device of a meter.

"Year": calendar year, according to the Gregorian calendar.

1.3 Application of the Regulations

1.3.1 These Regulations apply to metering equipment;

- a) Associated with orders placed with suppliers on or after 1st July 2005 for installation at some time thereafter,
- b) Re-cycled on or after 1st July 2006, where the equipment is installed sometime thereafter,
- c) Currently in service, where a transition period of five years will be allowed to enable such meters to be assessed and re-certified or replaced as necessary,
- d) Currently held in stock, where a transition period of one year from the effective date of these Regulations (i.e. up to and including 30th June 2006) will be allowed to enable such meters to be installed, and in so doing will move into category 1.3.1 c),

Where the equipment is installed compulsorily by or at the behest of the supplier of the water or electricity for use for trade for measuring any supply of water or electricity to residential, commercial and light industrial use (and which are used in non-negotiated transaction).

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Part 2 CONDITIONS

2.1 Principles of Construction & Marking

2.1.1 Before meters can be produced with a view to use for trade in Abu Dhabi, the pattern or design must be approved for the class of use intended by a suitably accredited and approved national/international metrological body. That is to say such a body will have been accredited in relation to electricity meters as being a body which conforms to the criteria set out in ISO 17025. Compliance with the metrological requirements as mentioned in 3.2 and 4.2 will be a pre-requisite for such approvals depending on accuracy class requirement. Meters so approved and assessed as compliant with these regulations shall be listed in Appendix 5 and 6 of these regulations.

2.1.2 Metering Equipment shall be legibly & durably marked with as a minimum;

- a) The name or trade name of the manufacturer or his trademark,
- b) The year of manufacture and individual serial number,
- c) The metrological accuracy class of the meter,
- d) The last test date of the meter,
- e) The reference temperature if different than 23°C,

and, in addition, for **electricity meters**;

- f) The number of phases and number of wires for which the meter is suitable,
- g) The reference voltage and frequency,
- h) Ib and I_{max} rating of the meter,
- i) The insulation class,
- j) No of rev or pulses/kWh,

and, for **water meters**;

- k) Nominal flow rate (Q_n) in cubic metres or imperial gallons per hour,
- l) The letter 'V' or 'H', if the meter can operate only in either the vertical (V) or horizontal (H) position,
- m) One or more arrows showing the direction of flow,

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- n) The number of the certificate of approval preceded by the words “Certification No” or “Cert No”,
 - o) The maximum operating pressure in bar, if this can exceed 10 bar.
- 2.1.3 The Distribution Company shall be supplied with appropriate documentation to certify that all meters are manufactured and individually tested in accordance with the standards contained in or referred to in 3.2 and 4.2 and that this includes the more onerous environmental conditions also stipulated in clauses 3.2 and 4.2 of these regulations.
- 2.1.4 When procuring new meters, the authorised manufacturer shall be contracted to keep records of all meters supplied, including testing certification, for 10 years from the time of supply.
- 2.1.5 Meters shall be provided with suitable means of sealing metrological sensitive parts.

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2.2 Approvals and Accreditation

2.2.1 Before certain metering related activities can be carried out, approval must be gained from the Bureau. The activities for which approval must be gained are;

- p) Supply of meters
- q) Meter and Standards testing (on-site and laboratory)
- r) Meter installation and commissioning
- s) Meter repairing/recycling
- t) Sealing of metering equipment

2.2.2 Each activity for which approval must be gained has a set of minimum criteria which have to be met by the applicant company. These criteria include, but are not limited to;

- a) ISO accreditation
- b) Training and Competence
- c) Experience in the market
- d) Support network
- e) Audit and inspection

2.2.3 None of the activities in 2.2.1 can take place without prior Bureau approval.

2.2.4 The application process for approval of each activity in 2.2.1 is detailed in Appendix 1.

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2.3 Initial Verification/certification

- 2.3.1 Every meter shall be individually tested (series/batch testing of meters of same manufacturer, same size and same class of accuracy is acceptable) and calibrated in accordance with the applicable standard(s) by a duly authorised manufacturer, repairer or his appointed agent with an accredited laboratory. Such activity should be subject to initial verification/certification by an appropriately qualified inspection body.
- 2.3.2 Meters shall be tested according to Appendix 3 of these Regulations.
- 2.3.3 Measuring systems shall comply with these Regulations.
- 2.3.4 Each meter shall display the year it was last tested/certified.
- 2.3.5 Once verified/certified by the manufacturer or his agent, a meter may remain in service for a prescribed period of time (see Appendix 5 and 6) except where the meter is suspected to be malfunctioning.

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2.4 Positioning Of Metering Equipment

- 2.4.1 Meters shall be so installed as to ensure that they are reasonably accessible for subsequent reading, inspection, testing and maintenance. Due account should also be taken to allow the customer to read his own meter without requiring right of access to it from another party e.g. through an adjacent property.
- 2.4.2 A meter installed outside of a building shall be installed in a suitably protective housing to minimise environmental impact and unauthorised access. This is especially important in remote areas and farms. (See UK specification, Energy Networks Association (ex-Electricity Association), Technical Specification 12-3, Outdoor Meter Cupboards).
- 2.4.3 Notwithstanding 2.4.1 and 2.4.2, the Distribution Company shall;
- a) Determine where any meter should be positioned in relation to any premises. This shall normally be on the customer's premises unless it is more reasonable to place it outside those premises or in some other position,
 - b) Notify the customer of the location in which they propose to install a meter.
- 2.4.4 The customer may, in writing, giving reasons, request the Distribution Company to;
- a) Install the meter in a position other than that proposed,
 - b) Reposition the meter where the meter has already been installed.
- Any costs associated with such a request shall be as defined in the Distribution Company's published fees & charges.
- 2.4.5 Where the Distribution Company agrees to such a request under paragraph (2.4.4), they shall;
- a) Notify the customer in writing giving an estimate of the expenses likely to be incurred,
 - b) Ensure that the Distribution Company's right of access to the metering equipment (see 2.4.1) is assured.
- 2.4.6 Where the Distribution Company does not agree to such a request they shall notify the customer in writing of their reasons within fifteen working days of receiving the request.
- 2.4.7 Where remote out reading/AMR devices are used these shall be so installed as to ensure that they are reasonably accessible for reading, inspection, testing and maintenance. Such devices shall be non re-

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settable and sealed in accordance with these regulations.

2.5 Sealing

- 2.5.1 A security seal shall be fitted to all metering equipment to prevent access to components which may affect its metrological characteristics or affect the ability of the meter to record actual consumption. This security seal shall perform the function of;
- a) Identifying that no internal access has been gained to the meter,
 - b) That the meter functioned to acceptable standards when sealed,
- 2.5.2 The following requirements also apply;
- a) The manufacturers/testers stamp shall be placed on every seal (as appropriate),
 - b) Meters shall have a suitable security seal fitted by suppliers before any final verification/certification,
 - c) A security seal shall not be removed from the meter cover unless the meter is returned for repair.
- 2.5.3 A secondary seals shall be applied as appropriate by the Distribution Company to;
- a) Prevent access to live terminals or pipe termination points following installation,
 - b) Prevent access to and interference with connections that may affect the continuity or accuracy of the billing data.
- 2.5.4 The seal and sealing system that is used for the above applications shall be one that is approved by the Bureau see Appendix 2.
- 2.5.5 Seals used in 2.5.1 and 2.5.3 will never be the same.

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2.6 In-Service Testing and Reading of Meters

- 2.6.1 The Distribution Company or any accredited company duly authorised by them, may at any time, and shall if so requested in writing by the customer, test the accuracy of any meter which has been installed.
- 2.6.2 A meter shall be tested in accordance with these regulations in order to determine whether it falls within the prescribed limits of error. Accuracy tests should be based on Appendix 3 using working standards where testing is to be completed in situ. The customer should be provided with copies of all applicable tests.
- 2.6.3 The Distribution Company or any duly authorised company, may remove a meter from premises where it is necessary to do so for the purpose of testing. Continuity of supply must be ensured during this process therefore a replacement meter must be provided.
- 2.6.4 Where a test is carried out in accordance with these regulations (Appendix 3) at the request of the customer, and the meter, on being comprehensively tested, falls within the prescribed limits of error, the Distribution Company may recover from the customer a fee as published by them for carrying out the test.
- 2.6.5 Where a test is carried out on site, the resulting error of the meter shall be better than $\pm 2\%$ with an overall uncertainty of $\pm 0.6\%$ using appropriate working standards at a prevailing load of greater than 10% I_{max}. In certain cases, a laboratory test may also be carried out.
- 2.6.6 Where Distribution Companies fix charges in relation to any premises by reference to metered quantity, a reading from the meter installed in relation to those premises proved in accordance with this regulation shall be evidence of the quantity of electricity supplied to those premises, unless the meter is proved to register incorrectly.
- 2.6.7 A reading from a meter may be proved by producing the certificate of a person duly authorised by the Distribution Company to read the meter and certify the reading.
- 2.6.8 A meter shall be regarded as registering incorrectly if on being tested it is found to exceed the prescribed limits of error detailed in 2.6.5 and/or Appendix 3.
- 2.6.9 The meter shall be visited at least once in every year either as part of the meter reading function of the Distribution Company or as a separate visit. It shall be the duty of the Distribution Company or duly authorised meter reader to check the condition of the seals and condition of the meter and if not in compliance with these regulations report and initiate appropriate action.

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2.7 Re-Verification/certification

- 2.7.1 Each meter type shall have ascribed to it a certification life (time allowed to remain on circuit). This certification life will be different for electricity and water meters;
- a) **Electricity meters** - If no supporting evidence is available, a period of 10 years or such time that the meter ceases to operate within permitted margins of error, whichever is least. In any event no meter shall remain on circuit for periods exceeding 20 years (see Appendix 5). The Meters (Certification) Regulations 1998, Statutory Instrument No. 1566, Schedule 4, issued by Ofgem (in the UK) will be used as one reference for determining meter certification periods,
 - b) **Water meters** - If no supporting evidence is available, a period of 5 years or such time that the meter ceases to operate within permitted margins of error, whichever is least. In any event no meter shall remain on circuit for periods exceeding 10 years (see Appendix 6). Internationally recognised experience/expertise may be used for determining meter certification periods.
- 2.7.2 The Distribution Company shall maintain auditable records of all meters on circuit and their projected date of replacement (in line with 2.7.1).
- 2.7.3 All re-cycled meters must be re-verified/certified by an accredited laboratory. Testing shall be in accordance with Appendix 3 of these regulations. The initial certification/test date shall be removed/obscured and the certification/test date of the accredited laboratory marked on the meter.

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2.8 Records

2.8.1 The following records shall be kept and made available for inspection by the Bureau or it's representative at any time;

- a) Test certificates of all in service meters,
- b) Meter test equipment/standards calibration history,
- c) Meter re-certification or replacement schedules,
- d) Results of all adhoc on-site or laboratory meter testing initiated by the customer or the Distribution company,
- e) For every account, details of the meter(s) installed (see 2.1.2 for information to be stored),

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2.9 Public Information

2.9.1 The Distribution Company shall provide metering information as public handouts available from their offices and other suitable facilities. These should include but not be limited to the following advice;

- a) How to read a meter,
- b) Customer obligations on meter care,
- c) What to do if you think your bill is too high,
- d) Advice on who to contact with queries,
- e) How to get the meter checked,
- f) How to check for water leaks,
- g) Dispute resolution procedure,

2.9.2 Once metered consumption has commenced the Distribution Company is responsible for maintenance and replacement of the meter (irrespective to purchaser). However both the Distribution Company and the customer have obligations in keeping metering in good order and these obligations should be emphasised in published documentation.

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2.10 Transition

2.10.1 The Distribution Company in implementing this regulation shall produce a transition plan to ensure that all metering procedures are in compliance by nominated future dates.

2.10.2 The plan – which shall be provided to the Bureau by 1 Nov 2005 shall include but not be limited to;

- a) Phasing out of non compliant meters,
- b) Meter replacement programmes which take account of failure rates,
- c) Production of Public Information,
- d) Procurement of meters only in compliance with this regulation,
- e) Upgrading of Test & Calibration facilities,
- f) Implementation and phasing of 100% customer metering for both electricity and water,

And, for electricity meters;

- g) Phasing out of meters older than 20 years,

And for water meters;

- h) Phasing out of meters older than 10 years,

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2.11 Enforcement

- 2.11.1 Pursuant to Article 66 of Law No. 2 of 1998, failure of any person to comply with these regulations is contrary to the Law.
- 2.11.2 These Regulations are subject to modification or revocation by the Bureau at any time and from time to time.

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Part 3 ELECTRICITY

3.1 Accuracy requirements

3.1.1 Overall accuracy - Connections from a Distribution Company network to a customer shall have its Meter accuracy and equipment requirements determined by the capacity of the circuit to be metered. In general this means following the established requirements of the Metering & Data Exchange Code (MDEC) used for Settlement Metering at interface points between Generating/Desalination Companies and Distribution Companies, and TRANSCO. In summary this means for circuits rated;

a) **Active Energy**

Circuit capacity	Limits of error at stated power factor			
	@ unity pf			@ 0.5 lag & 0.8 lead pf
	120 to 21% ¹	20 to 6% ¹	5% ¹	120 to 10% ¹
Greater than 100 MVA	±0.5%	±1.0%	±1.5%	±1.0%
Greater than 10 MVA up to 100 MVA	±1.0%	±1.5%	±2.0%	±1.5%
Greater than 1 MVA up to 10 MVA	±1.5%	±2.0%	±2.5%	±2.0%
Greater than 100 kVA up to 1 MVA	±2.0%	±2.5%	±2.5%	±2.5%
Less than 100kVA	±2.5%	±2.5%	±2.5%	±3.0%

¹ percentage of rated current.

² reactive power limits of error apply only where measurement is included in a new meter.

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b) **Reactive Energy**

Circuit capacity	Limits of error at stated power factor	
	@ zero pf	@ 0.866 lag & 0.866 lead pf
	120 to 10% ¹	120 to 10% ¹
Greater than 100 MVA	±3.0%	±4.0%
Greater than 10 MVA up to 100 MVA	±3.0%	±4.0%
Greater than 1 MVA up to 10 MVA	±4.0%	±5.0%
Greater than 100 kVA up to 1 MVA	±4.0% ²	±5.0% ²
Less than 100kVA	±4.0% ²	±5.0% ²

¹ percentage of rated current.

² reactive power limits of error apply only where measurement is included in a new meter.

3.1.2 Metering equipment accuracy

Circuit capacity	Meters		Measurement Transformers	
	kWh	kVArh	Current	Voltage
Greater than 100 MVA	0.2S	2.0	0.2S	0.2
Greater than 10 MVA up to 100 MVA	0.2S	2.0	0.2S	0.2
Greater than 1 MVA up to 10 MVA	0.5S	3.0	0.2	0.5
Greater than 100 kVA up to 1 MVA	1.0	3.0	0.5	0.5
Less than 100kVA	2.0	3.0	0.5	N/A

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3.1.3 Main & Check requirements

Circuit capacity	Meters		Measurement Transformers	
	kWh	kVArh	Current	Voltage
Greater than 100 MVA	Main & Check	Main & Check	Main & Check	Main & Check
Greater than 10 MVA up to 100 MVA	Main & Check	Main & Check	Main & Check	Main
Greater than 1 MVA up to 10 MVA	Main & Check	Main	Main	Main
Greater than 100 kVA up to 1 MVA	Main	Main	Main	Main
Less than 100kVA	Main	Main	Main	N/A

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3.2 Meters

3.2.1 Where an electricity customer is to be charged for his supply, wholly or partly by reference to the quantity of electricity supplied, the supply shall be given through, and the quantity of electricity shall be ascertained by, an appropriate meter.

3.2.2 For the purposes of these regulations a meter is an appropriate meter if it complies as a minimum with the requirements of either;

- a) IEC 62053-11: Electromechanical meters for active energy (classes 0.5, 1 and 2),
- b) IEC 60145 : Var-hour (reactive energy) meters,
- c) IEC 62053-21: Static Meters for active energy (classes 1 and 2),
- d) IEC 62053-22: Static Meters for active energy (classes 0.2S and 0.5S),
- e) IEC 62053-23: Static Meters for reactive energy (classes 2 and 3),

as appropriate and as amended from time to time, **and**,

- f) IEC 62052-11: Electricity metering equipment (AC) - General requirements, tests and test conditions, Part 11: Metering equipment, **and**,
- g) it is in compliance with these regulations, **and**,
- h) it has been type approved by a internationally recognised laboratory.

3.2.3 All new meters shall additionally be expected to operate in the prevailing environmental conditions in the Emirate of Abu Dhabi. In particular such meters shall perform within prescribed error for ambient temperatures up to 60°C and humidity up to 95% condensing.

3.2.4 All meters shall record, as a minimum;

- a) The cumulative active energy consumption (in watt-hours) in accordance with applicable standards,
- b) Where a meter is used with an in built reactive energy (VARh) measurement capability, the cumulative reactive energy consumption (in var-hours) shall be recorded, and,

Either;

- c) Active energy demand values, programmable (in 5 minute increments) from 5 minutes duration to 1 hour, or,

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- d) A voltage free pulse output that can be connected to any data collection device or outstation.
- 3.2.5 All new meters shall be sized by the Distribution Company for the likely range of load current expected to be drawn by the customer.
- 3.2.6 The meter shall be provided;
 - a) By the Distribution Company or
 - b) By the customer, subject to agreement with the Distribution Company.
- 3.2.7 If the customer refuses or fails to take his supply through an appropriate meter provided and installed in accordance with these regulations, the Distribution Company may refuse to give or may discontinue the supply.
- 3.2.8 A register of approved, compliant meters shall be kept by the Bureau. This register will include meters that have been submitted for inclusion by Manufacturers or Suppliers (see Appendix 5), and will be issued by the Bureau at least annually along with the current certification life of each meter.

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3.3 Measurement Transformers

- 3.3.1 Where required, all new measurement transformers shall meet the requirements of IEC 60044, the accuracy limits described in 3.1.2 and procured with a test certificate.
- 3.3.2 Where new measurement transformers are installed on an existing circuit, the errors of the meter should be checked to ensure the overall accuracy is within the limits set by these regulations (see 3.1). Where the overall accuracy is outside the limits, the meter(s) shall be recalibrated.
- 3.3.3 Newly installed meters shall be compensated for measurement transformer errors in all cases and without exception.
- 3.3.4 Where a new meter is installed on an existing circuit via existing measurement transformers, the following steps should followed in order to ascertain the errors of the measurement transformers, and apply them to the new installation;
- a) Use individual measurement transformer test certificate from existing records,
 - b) Obtain individual measurement transformer test certificate from measurement transformer company's records,
 - c) Obtain statistical error information from measurement transformer companies of errors of certain batches of measurement transformers,
 - d) Allow an error equal to the accuracy class across the meter error curve to allow for the worst case scenario.
- 3.3.5 Where these regulations require a main and check meter (see 3.1.3) they shall be fused separately at the Voltage Transformer.
- 3.3.6 Due account shall be taken of the burden connected to a measurement transformer and factored into any compensation corrections applied to the meter(s).
- 3.3.7 Adequate test facilities shall be provided at the meter(s) to allow on-site testing, continuity of data and safe working practices.
- 3.3.8 Where adjacent circuits supply the same customer, these are to be metered separately. Summation CT's are not to be used unless by prior agreement with the Bureau on a case by case basis.

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3.4 Standards

- 3.4.1 This section applies to test facilities used to verify the performance of Electricity Meters to be used for Revenue purposes in the Abu Dhabi Electricity Sector. They apply equally to manufacturers and those facilities of the sector used for the purpose of test and calibration of watt-hour meters.
- 3.4.2 Principles as outlined in;
- a) IEC 60736 – Testing equipment for testing electrical energy meters, **and**,
 - b) OIML D5 – Principles for the establishment of hierarchy schemes for measuring instruments, shall be observed,
- shall be observed.
- 3.4.3 The following pieces of test equipment are deemed by these regulations to be Standards;
- a) Reference Standards
 - b) AC/DC Transfer Standards
 - c) AC Transfer Standards
 - d) Working Standards
- 3.4.4 All Standards shall be maintained and calibrated at the following intervals by a bureau approved accredited laboratory;

Standard type	Maximum period between calibrations
Reference Standards	2 year
AC/DC Transfer Standards	2 year
AC Transfer Standards	1 year
Working Standards	6 months

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Test reports provided by bureau approved accredited laboratories, shall be retained for inspection on request by the Bureau.

- 3.4.5 The overall uncertainty of measurement during any testing shall be calculated in accordance with UKAS publication; The Expression of Uncertainty and Confidence in Measurement: M3003. The confidence level in the determination of the overall uncertainty shall be 95% or greater.
- 3.4.6 The overall uncertainty of energy measuring systems shall not be greater than those values listed in Table 1 below.

Table 1 Maximum Uncertainty for Meters

Meter Class	0.5S			1			2		
Power Factor	1	0.5 lagging	0.5 leading	1	0.5 lagging	0.5 leading	1	0.5 lagging	0.5 leading
Error	±0.1	±0.15	±0.2	±0.2	±0.3	±0.4	±0.3	±0.45	±0.6

- 3.4.7 Apparatus used for the regulating and testing of electricity meters shall cease to be used if periodic verification shows the instrument to be inaccurate or unstable. Such apparatus must not be brought back into service until it has been repaired and re-calibrated.
- 3.4.8 For any test load, the load applied to a working standard integrating meter shall not be less than 25 % or more than 125 % of its full load rating. For a working standard wattmeter, the applied load shall not be less than 40 per cent or more than 100 % of its full scale or range reading.

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Part 4 WATER

4.1 Accuracy requirements

- 4.1.1 Overall accuracy - Connections from a Distribution Company network to a customer shall have its meter accuracy and equipment requirements determined by the size of the supply to be metered i.e. bigger supply requires higher overall accuracy. In summary this means for supplies;

	Limits of error	
	Lower flow rate zone	Upper flow rate zone
For flows in pipe work with internal diameters	$Q1 \leq Q < Q2$	$Q2 \leq Q \leq Q4$
Up to 50mm / 2"	±5.0%	±2.0%
Greater than 50mm / 2"	±3.0%	±1.0%

- Q Flow rate
 Q1 Minimum flow rate
 Q2 Transitional flow rate
 Q3 Permanent (Highest) flow rate
 Q4 Overload flow rate

4.1.2 Metering equipment accuracy

	Limits of error	
	Lower flow rate zone	Upper flow rate zone
For flows in pipe work with internal diameters	$Q1 \leq Q < Q2$	$Q2 \leq Q \leq Q4$
Up to 50mm / 2"	±5.0%	±2.0%
Greater than 50mm / 2"	±3.0%	±1.0%

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4.2 Meters

- 4.2.1 Where a water customer is to be charged for his supply, wholly or partly by reference to the quantity of water supplied, the supply shall be given through, and the quantity of water shall be ascertained by, an appropriate meter.
- 4.2.2 For the purposes of this regulation a meter is an appropriate meter if it complies as a minimum, with the requirements of;
- a) ISO 4064-1 – Measurement of water flow in closed conduits – Meters for cold potable water - Part 1: Specifications, **and**,
 - b) ISO 4064-2 – Measurement of water flow in closed conduits – Meters for cold potable water - Part 2: Installation requirements and selection, **and**,
 - c) ISO 4064-3 – Measurement of water flow in closed conduits – Meters for cold potable water - Part 3: Test methods and equipment,

Or,

- a) ISO 7858-1 - Measurement of water flow in closed conduits – Combination meters for cold potable water - Part 1: Specifications, **and**,
- b) ISO 7858-2 - Measurement of water flow in closed conduits – Combination meters for cold potable water - Part 2: Installation requirements, **and**,
- c) ISO 7858-3 - Measurement of water flow in closed conduits – Combination meters for cold potable water - Part 3: Test methods,

And,

- a) OIML R49-1 – Water meters intended for the metering of cold potable water, Part 1: Metrological and technical requirements,
- b) OIML R49-2 - Water meters intended for the metering of cold potable water, Part 2: Test methods,
- c) OIML R49-3 - Water meters intended for the metering of cold potable water, Part 3: Test report format,
- d) OIML D4 – Installation and storage conditions for cold water meters as appropriate and as amended from time to time, **and**,

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- e) It is in compliance with these regulations, **and**,
 - f) It has been type approved by a internationally recognised laboratory.
- 4.2.3 All new meters shall be sized by the Distribution Company to cater for the likely range of flows to be expected by the customer without undue pressure loss.
- 4.2.4 All new meters shall additionally be expected to operate in the prevailing environmental conditions in the Emirate of Abu Dhabi. In particular such meters shall perform within prescribed error for ambient and water temperatures up to 60°C and humidity up to 95% condensing.
- 4.2.5 The meter shall be provided:-
- a) by the Distribution Company or
 - b) if agreed by the Distribution Company, by the customer.
- 4.2.6 All meters shall record, as a minimum;
- a) Cumulative volume consumption in cubic metres (m³) or imperial gallons (g),
- And, **preferably**,
- b) Flow rate measured in cubic metres per hour (m³/h) or imperial gallons per hour (g/h),
- In addition, shall have the ability to read down to at least two decimal places of a cubic metre or gallon.
- 4.2.7 A register of compliant meters shall be kept by the Bureau. This register will include meters that have been submitted for inclusion by Manufacturers or Suppliers (see Appendix 6), and will be issued by the Bureau from time to time along with the deemed certification life.

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4.3 Standards

4.3.1 This section applies to test facilities used to verify the performance of Water Meters to be used for Revenue purposes in the Abu Dhabi Water Sector. They apply equally to manufacturers and those facilities of the sector used for the purpose of test and calibration of water meters.

4.3.2 Principles as outlined in;

- a) OIML D7 – The evaluation of flow standards and facilities used for testing water meters, **and**,
- b) OIML D5 – Principles for the establishment of hierarchy schemes for measuring instruments,

shall be observed.

4.3.3 The following pieces of test equipment are deemed by these regulations to be Standards;

- a) Calibrated reference device i.e. calibrated tank, reference meter, etc,
- b) Time measurement device,
- c) Flow rate measurement device,

4.3.4 All Standards shall be maintained and calibrated at the following intervals by a bureau approved accredited laboratory;

Standard type	Maximum period between calibrations
Reference Standards	2 years
Flow Standard	1 year
Timing device	1 year
Water temperature & pressure measuring devices	1 year
Weighing device	1 year
Reference Meter	6 months

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Test reports provided by bureau approved accredited laboratories, shall be retained for inspection on request by the Bureau.

Issued in Abu Dhabi

On **1st July 2005**

On behalf of the **Regulation and Supervision Bureau for the Water and Electricity Sector in the Emirate of Abu Dhabi** by:

ZAAL MOHAMMED ZAAL AL HAMEERI
CHAIRMAN

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Part 5 APPENDICES

5.1 Appendix 1 – Approval Process

5.1.1 Before meters can be purchased for installation, each device shall be submitted to the Bureau for approval.

5.1.2 The attached form shall be completed in full and submitted with any additional supporting information to;

The Director General
The Regulation & Supervision Bureau
PO Box 32800
Abu Dhabi
United Arab Emirates

5.1.3 Applications for approval will normally be processed within one calendar month of receipt. However, if applications are deemed incomplete or additional information required, this may be sought from the applicant or from third parties to reach a fair decision and the approval process will be delayed accordingly.

5.1.4 Where approval is refused for an activity, the applicant may re-submit an application no sooner than six months from the dated previous application.

5.1.5 Approval for meters may be sought by any party.

5.1.6 A fee, as defined in the Bureau's Current Scale of Charges and Services, shall accompany each application, without such a fee the application will not be processed, and therefore approval will not be given.

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Application for approval

Please indicate which approval is being sought (only one per application);

5.1.1 Meter – Use; Water / Electricity, Model;, Rating;, Accuracy Class;

5.1.2 Meter/Standards testing & certification (laboratory) – Security Seal identification; C

5.1.3 Meter Installation, site testing and commissioning – Security Seal identification; I

5.1.4 Meter Repairing/recycling – Meter Use; Water / Electricity, Model;, Rating;, Accuracy Class;

Applicant details

Company name;
Registered address;
.....

Trading address;
(if different to registered address)

Contact details; Name
Email
Tel No
Fax No

Supporting evidence

ISO accreditation(s);

Audit and inspection regime;

Experience in the market;

International recognition (approvals);

Training and Competance of staff;

Support network; (Please continue on separate sheet)

Declaration

The information supplied in this application is correct to the best of my knowledge.

Signed;

Print name; Position in company; Date;

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5.2 Appendix 2 – Sealing

- 5.2.1 Security seals that are fitted to any part of the metering equipment shall be made up of two components;
- a) The ferrule, and,
 - b) The wire rope.
- 5.2.2 The ferrule shall;
- a) Be a tin-plated, annealed, copper ferrule,
 - b) Be not less than 5.0mm nor greater than 7.0mm long,
 - c) Have an internal diameter which is not less than 1.98mm nor greater than 2.28mm,
 - d) Be of some constant cross section of such a size and shape so that it's external perimeter lies within a circle whose diameter is not less than 4.06mm nor greater than 4.6mm and the wall is nowhere less than 0.72mm thick,
- 5.2.3 The wire rope shall;
- a) Be manufactured from 7 strands of drawn, class Z, zinc coated wire complying with BS EN 10264,
 - b) Have a diameter of not less than 0.914mm, and,
 - c) Have a breaking load of not less than 880N.
- 5.2.4 Only reputable companies shall be used for the supply of sealing pliers and dies i.e. quality assurance accredited.
- 5.2.5 The following information relating to individually identifiable sealing pliers and dies shall be retained as appropriate;
- a) Names and dates of issue and return,
 - b) Those lost and stolen,
 - c) Those destroyed in a controlled and auditable manner,
- 5.2.6 Duplicate dies shall not be retained.
- 5.2.7 Sealing pliers with dies that do not make legible impressions shall not be used.
- 5.2.8 Sets of dies that have been damaged e.g. 5.2.7 or are no longer required e.g. the person assigned to them leaves the company, shall be destroyed in a controlled and auditable way.

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- 5.2.9 Sealing pliers shall be individually numbered and the way in which they are managed falls into two categories;
- Those used mainly in the laboratory to seal the meter at the certification phase will be closely monitored and normally kept in a secure place with limited access e.g. a safe. A signing in and out record of use shall be maintained stating when a particular crimping tool was used and by whom. Overnight use shall not be permitted,
 - Those used at a customer premises to seal associated metering equipment at the installation phase will be issued on a per person basis. Records shall be kept and maintained showing who has been issued with which crimping tool.
- 5.2.10 Security seal ferrule identification marking shall take the following format;
- On one side, the company's three alpha character code (see Appendix A) prefixed by either 'C' for certification seal or 'I' for installation seal,
 - On the other side, a three digit number starting from 001, traceable to a person.
- 5.2.11 Approved sealing identification codes;
- Certification Seals – Approved companies

Company name	Company identification code	Start date
e.g. Abu Dhabi Distribution Company e.g. Al Ain Distribution Company e.g. Iskra Metering	C ADD C AAD C ISK	

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b) Installation Seals - Approved companies

Company name	Company identification code	Start date
e.g. Abu Dhabi Distribution Company e.g. Al Ain Distribution Company	I ADD I AAD	

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5.3 Appendix 3 – Meter Testing – Electricity

- 5.3.1 Where an IEC standard states it is applicable to newly manufactured meters, the requirements of this regulation are, in the following instances, applicable to re-cycled meters also. Some subjects will be covered by the IEC standard in part or full. In the case of inconsistency, the appropriate IEC standard shall prevail.
- 5.3.2 In addition to the requirements of the appropriate IEC standard, prior to carrying out testing any alternating current watt-hour meters, the circuits of the meter shall have been energised for sufficient time to reach thermal stability. It shall be deemed sufficient time when;
- a) The voltage circuits of meters under test, and,
 - b) The voltage circuits of working standard integrating meters, have been energised for period of one hour, or half an hour if a current of not less than either 10% of basic current or 5% of marked current, is applied to the current circuits of the meters (non-registration and starting current tests may be carried out during the pre-heating period providing that the above is adhered to).
- 5.3.3 Appropriate IEC standard shall be referenced for the following;
- a) Reference Conditions
 - b) Test of no-load condition
 - c) AC voltage test
- 5.3.4 The rate of advance of a meter over a test period shall be obtained by one of the following;
- a) Reading the electro-mechanical register or electronic display on or connected to the meter,
 - b) Monitoring the rotation of the disc or pulse output of the meter.
- 5.3.5 The tests in Table 2 shall be carried out by one of the following methods;
- a) *Method A test*
A long period dial test where the advance of a kWh display, which is part of or connected to a meter under test, is compared with the advance of a precision kilowatt-hour meter
 - b) *Method B test*
A short period test where the rate of advance of a meter under test is compared to the rate of advance of a precision kilowatt-hour meter, or,

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- c) *Method C test*
A short period test where the actual rate of advance of a meter, when tested under constant power conditions over a specified test period, is compared to the calculated rate of advance for those conditions.

5.3.6 Reference conditions for all testing;

- a) *Dial tests*
Where all the errors of repaired meters are determined by the method B or method C test, an additional test in accordance with method A shall be carried out. The method A test shall be carried out at one of the loads used for the method B or method C test. The error obtained by the method A test shall not differ by more than 0.6 % from the error obtained at the same load value by the method B or method C test.
- b) *Duration of test*
The tests described in 5.3.5 shall continue until the error of meters can be calculated within a tolerance not greater than plus or minus 0.2 %.
- c) *Conditions for mixing methods of test*
The method A test may be used for intermediate and high loads, at unity power factor and at 0.5 power factor, and the Method B or Method C test for the low load. This can be done provided an additional Method B or Method C test is carried out at one of the test load values where the Method A test was used.

5.3.7 Multi-register meters

- a) Induction meters
- i. All induction meters with more than one register shall be tested on one register in accordance with 5.3.6 and Table 2 and on each and every other register at a low load using the method A, method B or method C test and at an intermediate or high load using the method A test.
 - ii. For the same load conditions the maximum permitted difference between the error on one register, expressed as a percentage, and the error on any other register, expressed as a percentage, is 1%.
- b) Static meters
- i. All static meters with more than one register shall be tested on one register in accordance with 5.3.6 and Table 2.

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- ii. For repaired static meters with more than one register;
- Where the total units are the sum of all the registers, a further test shall be carried out on each and every other register using method A, but,
 - Where the total units are recorded on one register, only that register is required to be tested in accordance with 5.3.6 and Table 2.

5.3.8 Every polyphase meter shall be tested on a circuit having a phase relationship for which that meter is designed, provided that three phase, four wire polyphase meters may be tested without current in the neutral conductor.

5.3.9 Polyphase meters shall be tested by using;

- a polyphase kilowatt-hour energy standard,
- 2 or 3 single phase kilowatt-hour energy standards, or,
- 2 or 3 single phase watt-meters.

5.3.10 For margins of error see Table 2 and 3

Table 2 Load Points for Testing

Test number and load	Power factor	Test load in terms of marked current				Meter type	Polyphase meter load
		Basic / maximum	Maximum continuous	Long range	Short range		
1 (high)	1	I _{max}	100%	100%-200% (Note 1)	100%-125% (Note 1)	Single and polyphase	Balanced
2 (intermediate)	1	I _b or 125%I _b	Any load between 25%-75% of the value specified for test number 1 (Note 1)			Single and polyphase	Balanced
3 (low)	1	5%I _b	1.67% (Note 2)	5%	5%	Single and polyphase	Balanced
4 (inductive)	0.5 (Note 3)	I _b or I _{max}	100%	The same value selected for test number 1		Single and polyphase	Balanced
5 (high - per element)	1	I _b	100%	The same value selected for test number 1		Polyphase	One phase loaded in turn
6 (inductive - per element)	0.5 (Note 3)	I _b	100%	The same value selected for test number 1		Polyphase	One phase loaded in turn
7 (starting-current)	1	0.5%I _b to 1.0%I _b	0.5% to 1.0%	0.5% to 1.0%	0.5% to 1.0%	Single and polyphase	Balanced

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Table 3 Load Point Error Limits

	<i>Maximum meter error</i>						
	<i>Class 2 meters</i>		<i>Class 1 meters</i>		<i>Class 0.5S meters</i>		
<i>Test number and load</i>	<i>Tested with current transformers connected</i>	<i>Tested without current transformers connected</i>	<i>Tested with current transformers connected</i>	<i>Tested without current transformers connected</i>	<i>Tested with current & voltage transformers connected</i>	<i>Tested with current transformers only connected</i>	<i>Tested without current & voltage transformers connected</i>
1 (high)	+/- 1.5%	+/- 1.0%	+/- 1.0%	+/- 0.8%	+/- 1.1%	+/- 0.6%	+/- 0.4%
2 (intermediate)	+/- 1.5%	+/- 1.0%	+/- 1.0%	+/- 0.8%	+/- 1.1%	+/- 0.6%	+/- 0.4%
3 (low)	+/- 1.5%	+/- 1.0%	+/- 1.0%	+/- 0.8%	+/- 1.1%	+/- 0.6%	+/- 0.4%
4 (inductive)	+/- 1.5%	+/- 1.0%	+/- 1.0%	+/- 0.8%	+/- 1.1%	+/- 0.6%	+/- 0.4%
5 (high - per element)	+/- 1.7%	+/- 1.5%	+/- 1.2%	+/- 1.0%	+/- 1.3%	+/- 0.8%	+/- 0.6%
6 (inductive - per element)	+/- 1.7%	+/- 1.5%	+/- 1.2%	+/- 1.0%	+/- 1.3%	+/- 0.8%	+/- 0.6%

Note 1 Where a range is given, any value within that inclusive range may be selected.

Note 2 For maximum continuously rated prepayment meters, the low load test value may be twice the value shown.

Note 3 For test numbers 4 and 6, the inductive power factor shall be between 0.45 and 0.55 inclusive.

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5.4 Appendix 4 – Meter Testing – Water

5.4.1 Sample Test Certificate

Approved Test House Name:

Address:

Phone No:

Water Meter Inspection & Test Certificate No [1234]

Station		Account No		Job No	
Sector/Area		Plot		Villa/Flat No	

Reason for Meter Removal/Testing	Excessive Consumption	Working Performance	Leakage/Supply Disturbance/Other

Registered Meter Details		In-Situ Test Meter Details	
Meter Serial No		Meter Serial No	
Make & Model		Make & Model	
Meter Size		Meter Size	
Units - m ³ /gal		Units - m ³ /gal	
Reading at Removal		Reading at Installation	
Date of Removal		Date of Installation	
Working Condition prior to removal		Working Condition at time of Installation	
Date of Test		Date of Removal	
Working Condition at time of test		Reading at time of Removal	

Damage Report	
----------------------	--

Test Flow Rate - Litre		Test Pressure - Bar	Accuracy %	Test Duration
Q _{max}				
Q _n				
Q _{min}				
Remarks:				

Meter Submitted by:	Meter Repaired by:	Meter Tested by:	Responsible Officer:
Date:	Date:	Date:	Date:

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5.4.2 Guideline Procedure for In-situ Testing of Domestic Meters Using a Reference Meter;

- a) Identify the nature of the customer's complaint and note if the customer has carried out their own test and if so the method employed and the result of it,
- b) Check the installation of the meter for compliance with Water Supply Regulations, appropriate ISO/OIML standard(s) and note compliance or otherwise,
- c) Note the Meter Serial No, make and Approval Certificate No.
- d) Ensure as far as is practicable that there is no internal use of water by visual inspection and making sure that all internal water fittings are shut off.
- e) When it is certain that there is no internal use of water, check for leakage by taking two meter readings at 5 minute intervals. Note the readings.
- f) If there is any difference in the readings this will be an indication of leakage; advise the customer to have it repaired and terminate the check.
- g) Identify an accessible cold-water tap fed directly from premises supply pressure and attach a reference meter using a suitable adaptor,
- h) Set the flow at the tap at a high rate between $\frac{1}{4}$ Q_n and $\frac{1}{2}$ Q_n as measured by the reference meter and allow the tap to run for 2 minutes. Check the flow rate by filling a 200ml or 500ml cylinder, noting the time taken to fill. Note visually the flow of water (which must be steady and free from air) and the rotation rate of the meter register.
- i) Stop the flow and take initial readings on the customers and reference meters and note.
- j) Set the tap to approximately the flow rate and check as in 8 above and allow to run for 5 minutes.
- k) Stop the flow and note the final readings from both meters.
- l) Calculate the consumption on both meters and compare. Calculate the average flow rate and note.
- m) If the flow rate is outside the required range repeat the test by adjusting the flow rate.
- n) Repeat the test from 8 above at a flow rate between Q_t and 5Q_t and test for 20 minutes
- o) Give the customer a copy of the results sheet.

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Model Form Test Report

Address of premises including PO Box No:		
Name of Customer:		
Telephone No:		
Nature of Complaint		
Result and method of ant test by customer:		
Compliance of installation with standards and regulations:		
Meter Serial No	Make:	Model:
Meter Pattern approval No	Qn:	Qt:
Leakage Check	Reading 1:	Reading 2:
Flowrate test 1 (1/4 Qn to ½ Qn) – (5 minute duration)		
	Customers Meter	Ref Meter
Final Readings	-----m ³	-----m ³
Initial Readings	-----m ³	-----m ³
Quantities Indicated by Meter	-----m ³ (A)	-----m ³ (B)
Observed flowrate = B x 12	-----m ³ /hr	
Ref meter error from correction chart at observed flowrate	-----%	
Corrected value of B=B (1+E/100) =	----- (C)	
Observed meter error = $\frac{A - C}{C} \times 100$	-----% (Limit 2.5%)	
Flowrate test 2 (Qt to 5Qt) – (20 minutes duration)		
	Customers Meter	Ref Meter
Final Readings	-----m ³	-----m ³
Initial Readings	-----m ³	-----m ³
Quantities Indicated by Meters	-----m ³ (A)	-----m ³ (B)
Observed Flowrate = B x 3	-----m ³ /hr	
Ref meter error from correction chart at observed flowrate	-----%	
Corrected value of B=B (1+E/100) =	----- (C)	
Observed meter error = $\frac{A - C}{C} \times 100$	-----% (Limit 2.5%)	
Name:	Signed:	Date:

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5.5 Appendix 5 – Approved devices and certification periods (Electricity)

Meter manufacturer	Model	Certification period (Years)	Meter manufacturer	Model	Certification period (Years)
ABB	M81	10	OSAKI	OB94BM	10
ABB	T81	10	OSAKI	OQ9BM	10
AMPY	5192B	10	SCHLUMBERGER	G7Y2H 3/6	10
AMPY	5196B	20	SCHLUMBERGER	GE24B226	10
			SCHLUMBERGER	GH41A226	10
AUTOMETER	2KCH34	10	SCHLUMBERGER	GH41b226	10
			SCHLUMBERGER	GH42b226	10
ELSTER (ABB)	ALPHA 1600	10			
			SIEMENS	7CA441-7	10
ENGLISH ELECTRIC	C21B/M	20	SIEMENS	H2D5	10
FERRANTI	FNE34	15	ZAPTRONIX	ZAP03BS	10
FERRANTI	FNN2Q	20			
FLOTON	S301	10			
FUJI	FF23MJ	10			
GEC	C11B2T-H	10			
GEC	E43B 3B	10			
ISKRA	E62C	10			
ISKRA	E89C2	10			
ISKRA	E89C2-5	10			
ISKRA	E89E2	15			
ISKRA	T25C	10			
ISKRA	T31AT2	10			
ISKRA	T35E2	10			
ISKRA	T37E2	10			
ISKRA	T37E2-5S	10			
LANDIS & GYR	CL27-2	20			
LANDIS & GYR	CM170XF3	10			
LANDIS & GYR	YL11	20			
MITSUBISHI	BF32	10			
MITSUBISHI	MH-33G	10			
MITSUBISHI	MH33H	10			
MITSUBISHI	MH-34G	10			

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5.6 Appendix 6 – Approved devices and certification periods (Water)

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