Saudi Electricity Company	الشركة السعودية للكهرباء

SEC DISTRIBUTION MATERIALS SPECIFICATION	40-SDMS-01, Rev. 02
	DATE: 25-09-2010G

40-SDMS-01

REV. 02

SPECIFICATIONS

FOR

BOTTOM CONNECTED KILO-WATTHOUR METER

CONTENTS

LIST OF FIGURES

1.0 SCOPE

This SEC Distribution Materials Specification (SDMS) describes the minimum technical requirement for design, materials, manufacturing, inspection, testing, performance and supply of electro-mechanical Kilo-Watt-Hour (KWH) meters, intended to be used for revenue metering in the system of Saudi Electricity Company (SEC).

2.0 CROSS REFERENCES

2.1 This Specification shall be read in conjunction with SEC General Specification No. 01-SDMS-01 (latest revision) titled "General Requirement for all Equipment/Materials" which shall be considered as an integral part of this standard specification**.**

2.2 This Specification shall also be read in conjunction with SEC purchase order requirements**.**

3.0 APPLICABLE CODES AND STANDARDS

The latest revision of the following codes and standards shall be applicable for the equipment/material covered by this specification. In case of any deviation, the vendor/manufacturer may propose equipment/material conforming to equivalent alternate codes and standards. However, the provisions of SEC standards shall supersede the provisions of these standards in case of conflict.

3.1	**IEC 62053**	**- Class 0.5, 1 and 2 alternating current watt-hour meters**
3.2	**IEC-60514**	**- Acceptance of Class 2 watt-hour meters**
3.3	**IEC 6185811**	**- Thermal Evaluation and Classification of Electrical insulation**
3.4	**IEC 60028**	**- Copper Resistance**
3.5	**IEC 60060-2**	**- High Voltage Test Techniques**
3.6	**IEC-947-7-1**	**- Test Requirements of Terminal blocks**
3.7	**ASTM D-4098**	**- Thermosetting Resins**
3.8	**ASTM D-3935**	**- Polycarbonate Resins**

4.0 SERVICE CONDITIONS

4.1 The KWH-Meter will be installed indoor or outdoor. In outdoor installations, the KWH-Meter shall be enclosed in weatherproof fiberglass meter box. The air temperature inside the meter box may be regarded as 75°C due to direct solar radiation, plus the effect of any internal heating**.**

4.2 KWH-Meter shall operate within its accuracy class under the service conditions as given in the latest revision of SEC General Specifications No. 01-SDMS-01**.**

5.0 SYSTEM CONDITIONS

The KWH-Meter shall be suitable for operation in SEC distribution system conditions as per the latest revision of SEC General Specifications No. 01-SDMS-01.

6.0 DESIGN AND CONSTRUCTION

6.1 Case

6.1.1 The case of the meter shall be made of nonmetallic material. It shall be made of phenolic or high grade polycarbonate resin with clear glass window as given in Clause 6.2

6.1.2 The meter cover shall not be removable without the use of a tool after breaking the seals at its fixing sealable retaining screws.

6.1.3 Top suspension hook and bottom mountings shall be metallic. Thickness not less than 1.5 mm and shall be bolted / riveted to the meter case. The shape of the top suspension hook shall be oval.

6.1.4 The overall and mounting dimensions and top & bottom mountings arrangements shall be provided similar to the sketch as given in Figure No. SEC/KWH-01.

6.2 Window

Reinforced clear glass window shall be provided on meter cover for reading register, nameplate data and for the observation of the rotor movement. The glass over the window shall be air and dust tight and shall not be removable without breaking the seal. Fixing clips/screws for glass window shall be made of stainless steel or rust free material. Window glass fixing arrangement shall be suitable for re-fixing the glass cover when necessary.

6.3 Meter Frame

Meter frame shall be made of high class varnish coated steel or die cast aluminum alloy and shall provide distortion free fixing support to all measuring elements.

6.4 Terminals and Terminal Block

6.4.1 The terminals shall be grouped in a terminal block of adequate mechanical strength. They shall be arranged for front connection.

6.4.2 For whole current meters, it shall be easily possible to disconnect and reconnect the voltage terminals from the current terminals. The disconnecting device shall be inside the meter under the case cover.

6.4.3 An additional fixed voltage screw with side-grooved head shall be extended from voltage link to terminal block in order to connect voltage test lead easily during testing of the meter in the SEC laboratory.

6.4.4 The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there is no risk of loosening, undue heating of the conductors and the terminals. These terminals shall be provided with minimum two slotted head screws.

6.4.5 The terminals shall be suitable for copper conductors. The bore diameter for phase and neutral terminals shall be as given in Table No. 1 below:

Table No. 1

KWH-Meters	Terminals bore Diameter (mm)	Conductor Size
20(100) Amps	9 - 12	35 sq. mm soft drawn flexible copper, stranded
40(160) Amps		
1.5 (6) Amps	5.5	2.5 sq. mm soft drawn copper, single strand

6.4.6 Terminals with different potentials, which are grouped close together, shall be protected against accidental short-circuiting by keeping adequate clearance.

6.5 Terminal Cover

6.5.1 Both short and extended terminal covers shall be made of the same material that of the meter case.

Short terminal cover shall be suitable to cover the top of the terminal block only (Figure No. SEC/KWH-01).

Long /extended terminal cover shall be extended for 40 mm free space to cover the wiring and the bottom fixing screws (Figure No. SEC/KWH-01).

6.5.2 Terminal cover shall be provided with sealable retaining screws with holes suitable for sealing wire of diameter 2.5 mm maximum.

6.5.3 The terminal cover shall include information indicating the correct phase sequence and connections as per drawings No. SEC/KWH-04, 05 and 06.

6.5.4 Short and extended terminal covers shall be provided in separately packed cartons instead of packed with individual KWH-Meter. Type of terminal covers i.e. “SHORT TERMINAL COVER” and “EXTENDED TERMINAL COVER” shall be clearly marked on these cartons.
SEC purchase order will state the break-up quantities of these covers to be supplied by the vendor / manufacturer.

6.6 Register

6.6.1 The register shall be single rate cyclometer type and secured to the frame by means of screws. The register shall be capable of being removed and replaced without having to readjust the meshing with the worm.

6.6.2 Figures of the drums shall not be less than 4 mm in height and 3 mm in width. Figures shall be indelibly marked in Arabic as given below:

١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ٠

6.6.3 Figures on the drums shall be white on a black background. The scale representing fractions shall be marked red or white as given in Figure No. SEC/KWH-02.

6.6.4 No lubrication shall be required on any part of the register.

6.6.5 The register shall have decade indexing. No separate roller shall be provided for fractional units. The first roller shall be with calibration division and shall be continuously drawn. The number of rollers shall be as per Table Number 2.

6.6.6 The register of CT and CT-VT KWH-Meters shall be based on secondary values of current and voltage of CTs and PTs as follows:

CT-Meter 5 A
CT-VT-Meter 5 A and 110 V

Table No. 2

Kilo-Watt-hour Meter Type	Number of Rollers
Whole Current (WC)	6
CT Operated	5
CT & CT-VT Operated	

6.7 Sealing

6.7.1 KWH-Meter case and meter terminal covers shall be provided with independent sealing provisions.

6.7.2 Each KWH-Meter shall have its case cover individually sealed by manufacturer before it leaves its place of manufacturing.

6.7.3 SEC shall reseal each KWH-Meter after accuracy verification at SEC laboratory.

6.8 Meter Rotor Disc

6.8.1 KWH-Meter shall be provided with two rotor discs. (Figure No. SEC/KWH-04). KWH-Meters with one rotor disc shall also be acceptable provided, manufacturer shall submit documented evidence such as design criteria, test reports, list of customers and period of supply for the performance of such KWH-Meters. All these documents shall be forwarded to SEC for review and acceptance.

6.8.2 The top of the upper rotor disc face shall be provided with 100 divisions. Its perifery shall be provided with graduation and red or black calibration mark. (Figure No. SEC/KWH-04).

6.9 Rotor Bearing

The bottom bearing shall be double jewel and ball type or magnetic suspension type. No lubrication for the meter bearing shall be required during its service life.

7.0 ELECTRICAL REQUIREMENTS

7.1 Nominal/basic current (I_b), rated maximum current (Imax) and reference voltages shall be as given in Table No. 3**.**

Table No. 3

Kilo-Watt-hour Meter Type	Current Rating in Amps		Reference Voltage in Volts
	(I_b)	(Imax)	
Whole Current	20	100	400/230/133
Whole Current	40	160	
CT Operated	1.5	6	
CT - VT Operated	1.5	6	110

7.2 Whole current meter class two (2) shall be dual voltage (**400/230** and **230/133**V).

7.3 The power measuring elements for Whole Current (WC), CT and CT-VT KWH-Meters shall be as given in Table No. 4**.**

Table No. 4

Kilo-Watt-hour Meter Type	Number of Measuring Elements	Kilo-Watt-hour Meter Connections
Whole Current (WC)	3	3 Phase 4 Wire
CT Operated		
CT - VT Operated	2	3 Phase 3 Wire

7.4 Meter Constant

Meter Constant (K) is the relation between energy registered by the meter and the corresponding number of rotor revolutions i.e. Revolution per Kilo-Watt-Hour (rev/KWH). This KWH-Meter constant shall be verified during Routine test.

7.5 Temperature Rise

Temperature rise shall not exceed the values given in Table No. 5 with an ambient temperature not exceeding 55°C.

Table No. 5

Kilo-Watt-Hour Meter Parts	Temperature Rise in Degree Centigrade
Windings	50
External Surface of the Case	15

7.6 Dielectric Quality

The dielectric quality of insulation shall be suitable for service conditions as per SEC General Specifications No. 01-SDMS-01 (latest revision).

7.7 Power Losses

The apparent and active power required in each voltage and current circuits of KWH Meter at reference voltage / basic current, reference temperature and reference frequency shall not exceed the values as given in Table No. 6.

Table No. 6

Kilo-Watt-hour Meter Type	Current Coil	Voltage Coil
Whole Current (WC)	2.5 VA	10 VA & 2W
CT / CT-VT Operated	4.0 VA	12 VA & 3 W

7.8 Insulation

KWH-Meter shall withstand the following insulation level:

1. **Power Frequency AC Voltage** — **2 kV**
2. **Impulse Voltage (1.2/50 µs)** — **6 kV**

7.9 Short Time Overcurrent

The KWH-Meter shall withstand short time overcurrent as given in Table No. 7.

Table No. 7

Kilo-Watt-Hour Meter Type	Short Time Over Current
Whole Current	**Impulse Current 50 x I_{max} or 7 kA (whichever is less) and 25 x I_{max} or 3.5 kA (whichever is less) remains for a period of One Millisecond.**
CT / CT-VT	**10 I_{max} for a period 500 Milliseconds.**

7.10 Starting

KWH-Meter shall start and continue to run at the loads given in Table No. 8.

Table No. 8

Watt-hour meter Type	Percentage of Basic Current
Whole Current	**0.5**
CT / CT-VT	**0.4**

7.11 Meter Running at No Load

KWH-Meter rotor shall not make one complete revolution at any voltage between 80% and 110% of the reference voltage when the load in the current circuit is zero.

7.12 Calibration Adjustments

7.12.1 Each driving element of all type of KWH-Meters shall provide the adjustments with minimum plus and minus ranges as given in Table No. 9. These adjustments shall easily be accessible from the front or side of the meter with meter cover removed.

Table No. 9

Type Adjustments	Minimum Range of Rotation Speed of Kilo-Watt-Hour Meter Rotor		
	Whole Current	CT	CT- VT
Full Load	± 4%	± 2%	± 2%
Low Load			
Inductive Load	± 1%	± 1%	± 1%
Balanced Load			

7.12.2 Calibration adjustments with direction of control shall be clearly marked on each element.

7.12.3 All adjustments shall be locked or have provisions for locking to prevent change in KWH-Meter adjustments due to normal handling or vibrations.

8.0 ACCURACY

8.1 The Accuracy Class Index of the meter shall be as given in Table No. 10**.**

Table No. 10

Watt-hour Meter Type	Accuracy Class Index
Whole Current	2.0
CT	1.0
CT-VT	

8.2 KWH-Meter shall meet accuracy requirements for reference voltage as given in Clause 7.1**.**

8.3 Class two (2) KWH-Meter shall be designed for dual voltage applications and calibrated for one voltage. However, the meter shall be within class two (2) accuracy range for both voltages**.**

9.0 CALIBRATION

9.1 Every KWH-Meter shall be calibrated for error limits for the loads as given in Table No. 11**.**

Table NO. 11

Kilo-Watt-Hour Meter Type	Percentage Error Limits	
	Load 10 % I_b to I_{max} at Unity Power Factor	Load 50 % I_b to I_{max} at Power Factor 0. 5 Lagging
Whole Current	-2.0 to +2.0	
CT	-1.0 to +1.0	
CT, VT		

10.0 MARKING OF METERS

10.1 Every KWH-Meter shall be provided with a suitable size of nameplate inside Kilo-Watt-Hour Meter cover. Information on this nameplate shall be bilingual (Arabic and English). These shall be printed clearly, indelibly and readable from outside through glass window**.**

10.2 Nameplate shall include the following information**:**

(1) The manufacturer's name or trademark and place of manufacturing.

(2) Designation and type.

(3) The number of phases and the number of wires for which the meter is designed.

(4) The serial number and year of manufacturing.

(5) The reference voltage in the form of the nominal voltage of the system or the secondary voltage of the instrument transformer to which the meter is to be connected.

(6) The basic current and the rated maximum current; for example, 20(100) A.

(7) The reference frequency in Hertz. For example, 60Hz

(8) The constant of the KWH-Meter in the form rev/kWh.

(9) The class index of the meter.

(10) The reference temperature if different from 23°C.

(11) "Property of SEC"

(12) SEC Monogram

(13) SEC Purchase Order Number

(14) SEC item Number

10.3 Nameplate shall be included the information as given in Table No. 12**.**

Table No. 12

1	Manufacturer	*المصنع*
2	Type/Model	*نوع*
3	Phases	*أوجه*
4	Wires	*أسلاك*
5	Voltage/Volts/V	فولت
6	Amp. /A	امبير
7	Rev./kWH	دورة / كيلو وات ساعة
8	Frequency/Hz	هيرتز
9	Accuracy Class	درجة الدقة
10	Temperature °C	° م درجة الحرارة
11	Serial number/Year of Manufacturing	رقم التسلسل / السنة
12	Purchase order No.	رقم امر الشراء
13	SEC Item No.	رقم الشركة
14	Property of SEC	ممتلكات الشركة السعودية للكهرباء
15	SEC Monogram	SEC-01-01
16	Numerals **1 2 3 4 5 6 7 8 9 0**	ارقام ١ ٢ ٣ ٤ ٥ ٦ ٧ ٨ ٩ ٠

11.0 TESTING

11.1 Type Testing

11.1.1 Type test report from independent testing agency for each type of KWH-Meter shall be submitted.

11.1.2 Type test of the KWH-Meter shall include but not limited to the following tests:

(1) Mechanical strength and thermal stability for Kilo-Watt-Hour Meter case, cover, window, top and bottom mountings, terminals, terminal block, terminal cover and all associated plastic metallic parts of Kilo-Watt-Hour Meter.

(2) Non-flammability of terminal block.

(3) Dielectric test.

(4) Basic impulse voltage test.

(5) Temperature rise test.

(6) Power loss in voltage and current circuit.

(7) Accuracy test at reference condition and influence quantities as given in IEC-521.

(8) Meter constant test.

(9) Short time over current test.

(10) Influence of self-heating.

11.2 Routine Testing

11.2.1 Routine tests shall be performed for each KWH-Meters and then it shall be sealed. The manufacturer's seal shall be taken as an indication that each KWH-Meter has been tested and conformed to this SEC Specification, purchase order requirements and IEC-521.

11.2.2 Certified and complete routine test report for KWH-Meters shall be submitted for SEC review /approval prior to shipment.

11.2.3 Routine test of the KWH-Meter shall include but not limited to the following:

(1) Physical checking.

(2) Starting.

(3) No load (creeping)

(3) Insulation (60 Hz, 2 kV)

(5) Accuracy and calibration on balanced and single-phase loading.

(6) Dial test.

(7) Verification of meter constant.

12.0 CONNECTION DIAGRAM AND TERMINAL MARKING

KWH-Meter connections shall be suitable for WC, CT and CT-VT metering arrangements as given in Figure Nos. SEC/KWH-04, 05 & 06 respectively. Applicable connection diagram shall indelibly be marked inside the terminal cover of every KWH-Meter.

13.0 PACKING

13.1 Each KWH-Meter shall be packed in an individual carton capable of withstanding the rigours of transportation by Air or Sea or Truck. Other packing/shipping requirements shall be as given in SEC General Specification. 01-SDMS-01 (latest revision)**.**

13.2 Material Management Department shall be conducted for the details of SEC packing requirements**.**

14.0 GUARANTEE

14.1 The vendor shall guarantee the KWH-Meters against all defects arising out of faulty design or workmanship or defective material for a period of one year from date of commissioning or two years from the date of delivery which ever comes first. SEC certificates for date of commissioning shall be accepted**.**

14.2 KWH-Meters shipped to SEC warehouse shall be tested with opening meter cover for accuracy verification test for load as given in Clause 9.1 (Table No. 11)**.**

14.3 SEC will carryout the accuracy verification test for every KWH-Meter or on a sample basis. SEC shall specify the method of testing and test reports/certificates shall be acceptable by manufacturer.

14.3.1 Sample Testing:
Testing (accepting and rejection) shall be as per IEC-514.

14.3.2 Every KWH-Meter Testing:
Every KWH-Meter that is shipped to SEC warehouse shall be tested. KWH-meters that are failed in accuracy verification test shall be returned to manufacturer for replacement.

14.4 If no exceptions to this Specification is taken and no list of deviations is submitted, it shall be deemed that, in every respect, the KWH-Meters offered shall conform to this Specification. SEC interpretation of this Specification shall be accepted**.**

15.0 SUBMITTALS

Following shall be submitted by vendor/manufacturer along with the bidding document:

15.1 Filled in data sheet**.**

15.2 Original/clear copy of catalogues for offered item(s).

15.3 Copy of Type and Routine test reports for offered/ identical KWH-Meter.

15.4 Drawing for the following items**:**

(a) Lower and top bearings.

(b) Connection diagram.

(c) Overall dimensions.

(d) Terminal block.

(e) Mounting details.

(f) Sealing arrangement.

(g) Nameplate.

(h) Adjustment details.

(i) Terminal cover.

(j) Assembly drawing.

16.0 TECHNICAL DATA SCHEDULE

BOTTOM CONNECTED KILO-WATT-HOUR METER
(Sheet 1 of 3)

SEC Inquiry No. _____ Item No._____

REF. SEC.	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
3.0	**DESIGN AND CONSTRUCTION STANDARDS**		
	1. Standard to which Manufactured		
6.0	**MECHANICAL REQUIREMENTS**		
	1. Meter case	Nonmetallic	
	2. Window material	Glass	
	3. Frame material		
	4. Terminal bore dia.		
	5. Terminal cover	Short & Extended	
	6. Register without separate fraction roller	YES / NO	
	7. CT / CT-VT register secondary	YES / NO	
	8. Rotor disc	Two	
	9. Top rotor disc divisions	100	
	10. Top rotor disc perifery graduation and Calibration mark	Yes / No	
	11. Overall & mounting dimensions (mm)		
	12. Top suspension hook and bottom mountings	Metallic	
	13. Type of rotor bearing upper & lower		
	14. Weight of the meter (kg)		
7.0	**ELECTRICAL REQUIREMENT**		
	1. Nominal / Basic current I_b (A)		
	2. Over load current (A) Accuracy consideration (I_{max}) Thermal consideration		
	3. Torque (N.m)		
	4. Torque / weight ratio		
	5. Reference voltage (V)		

16.0 TECHNICAL DATA SCHEDULE

BOTTOM CONNECTED KILO-WATT-HOUR METER
(Sheet 2 of 3)

SEC Inquiry No. _____ Item No._____

REF. SEC.	DESCRIPTION	SEC SPECIFIED VALUES	VENDOR PROPOSED VALUES
	6. Measuring element 3 phase 4 wires meters 3 phase 3 wires meters	 3 2	
	7. Meter constant, K (Rev / kWH)		
	8. Temp. rise (°C) Windings External surface		
	9. Power losses (VA / Watt) Current coil Voltage coil		
	10. Insulation (kV) Power frequency Impulse (1.2 / 50 µs)		
	11. Short time over current (kA) Impulse One millisecond 500 millisecond		
	12. Starting current (% I_b)		
	13. Creep (+/- % of reference voltage)		
	14. Adjustment range (% I_b) Full load (100% I_b) Light load (10 % I_b) Inductive load Balance load		
	15. Accuracy class Index		
	16. Limits of error (%) 10 % I_b - I_{max} at unity power factor 50 % I_b at 50 % power factor lagging	(As per the Table No 11) YES / NO	
	Other loads (as per IEC 521)	YES / NO	
	17. Submittals as per this spec. enclosed	YES / NO	

16.0 TECHNICAL DATA SCHEDULE

BOTTOM CONNECTED KILO-WATT-HOUR METER
(Sheet 3 of 3)

SEC Inquiry No. _____ Item No._____

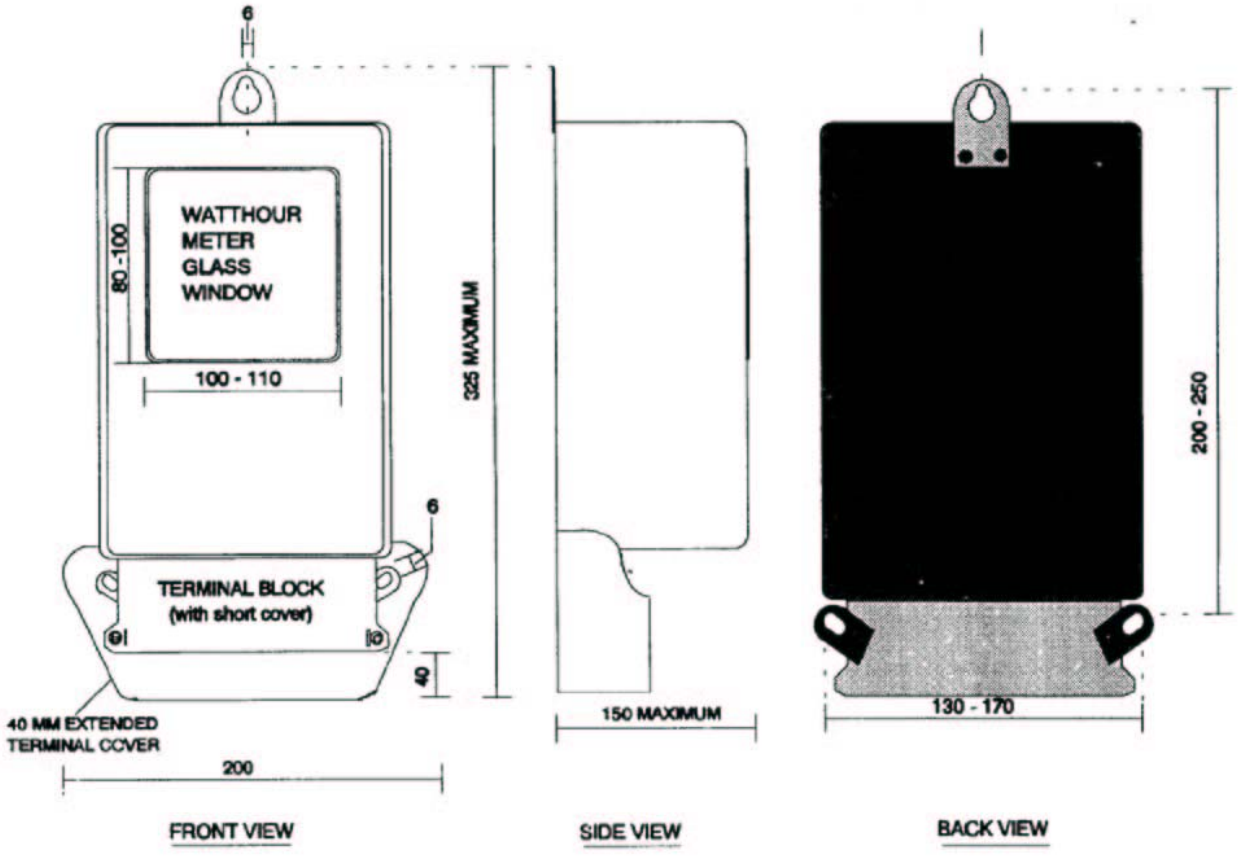
A. ADDITIONAL TECHNICAL INFORMATION OR FEATURES SPECIFIED BY SEC:

B. ADDITIONAL SUPPLEMENTARY DATA OR FEATURES PROPOSED BY BIDDER / VENDOR / SUPPLIER:

C. OTHER PARTICULARS TO BE FILLED UP BY BIDDER/VENDOR/ SUPPLIER:

D. LIST OF DEVIATIONS & CLAUSES TO WHICH EXCEPTION IS TAKEN BY THE BIDDER / VENDOR / SUPPLIER: (USE SEPARATE SHEET IF NECESSARY):

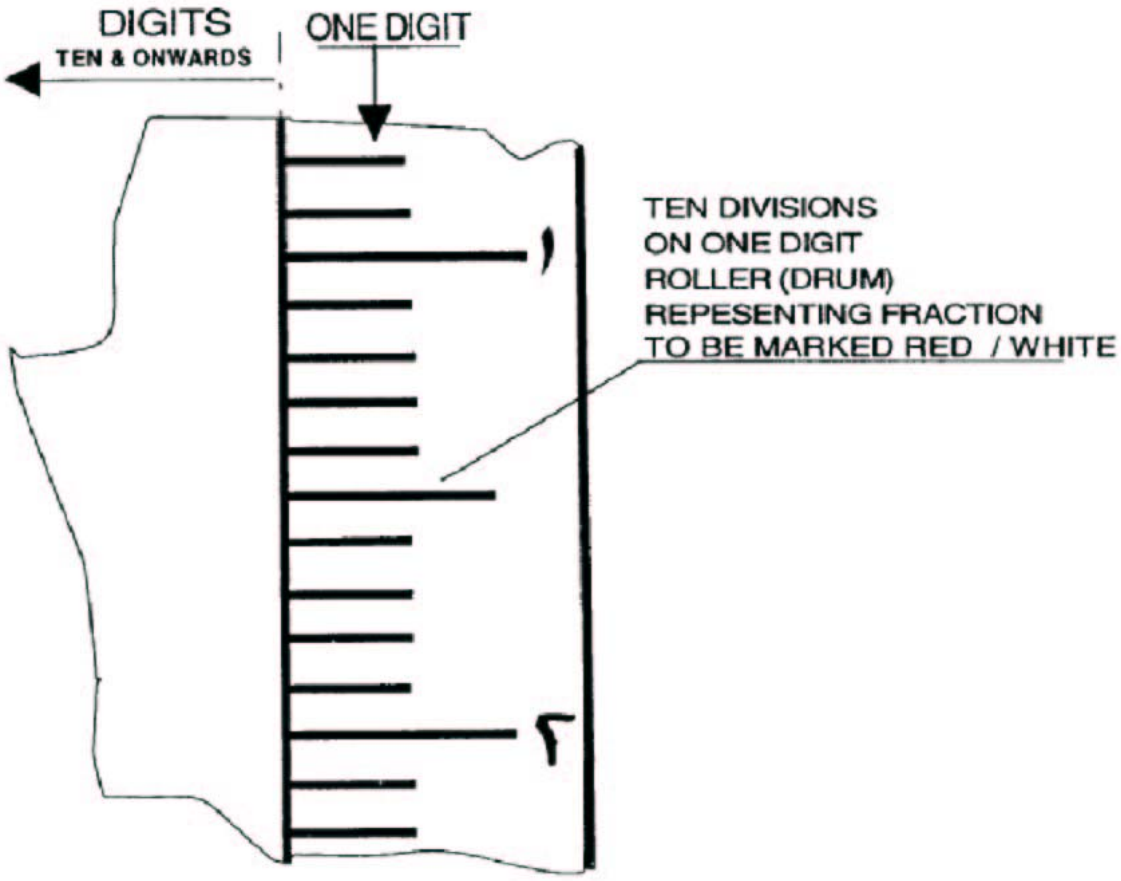
	MANUFACTURER OF MATERIALS/EQUIPMENT	VENDOR / SUPPLIER
Name of Company		
Location and Office Address		
Name and Signature of Authorized Representative and Date		
Official Seal / Stamp		



KWH METER
OVERALL AND MOUNTING DIMENSIONS

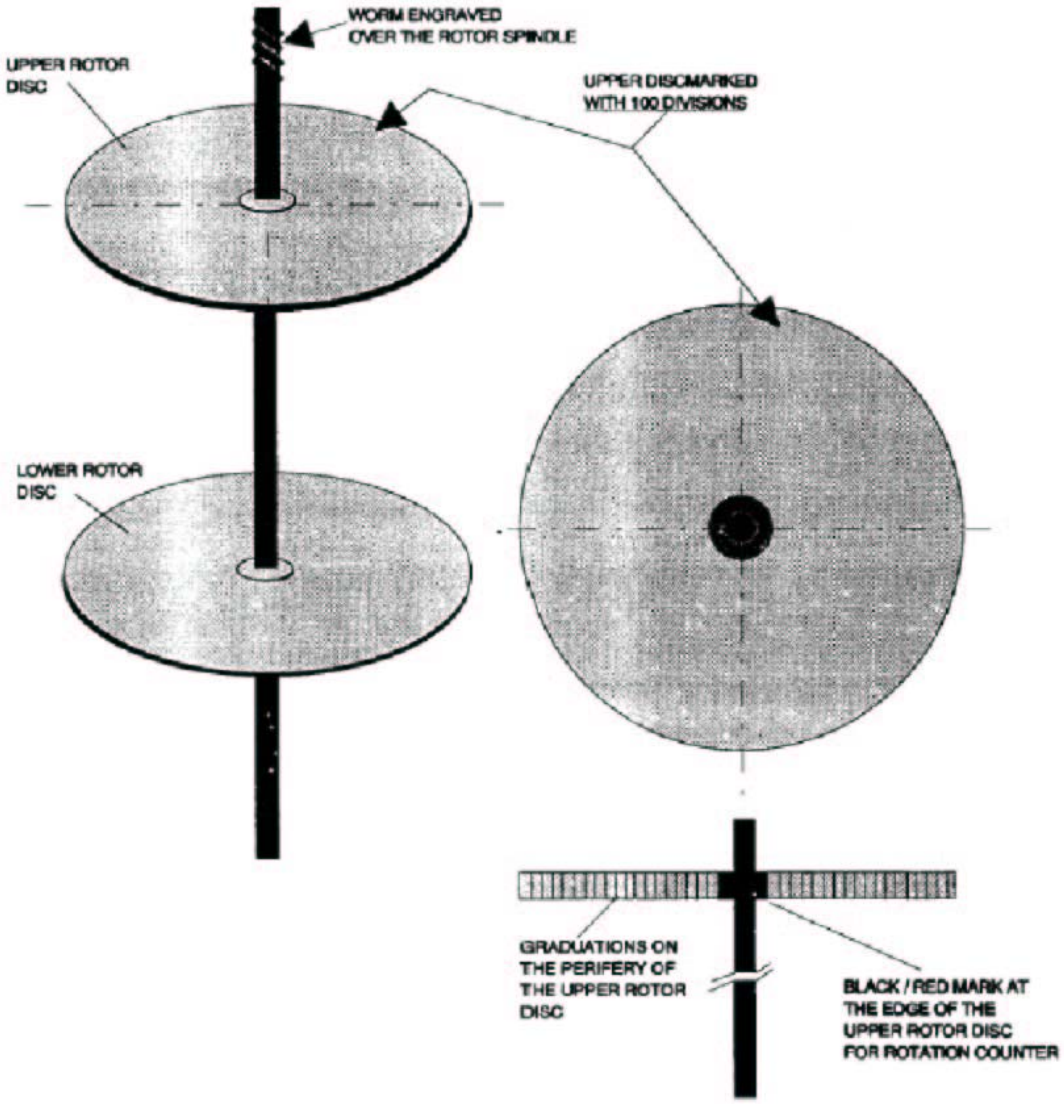
FIGURE NO.
SEC/KWH-01

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS



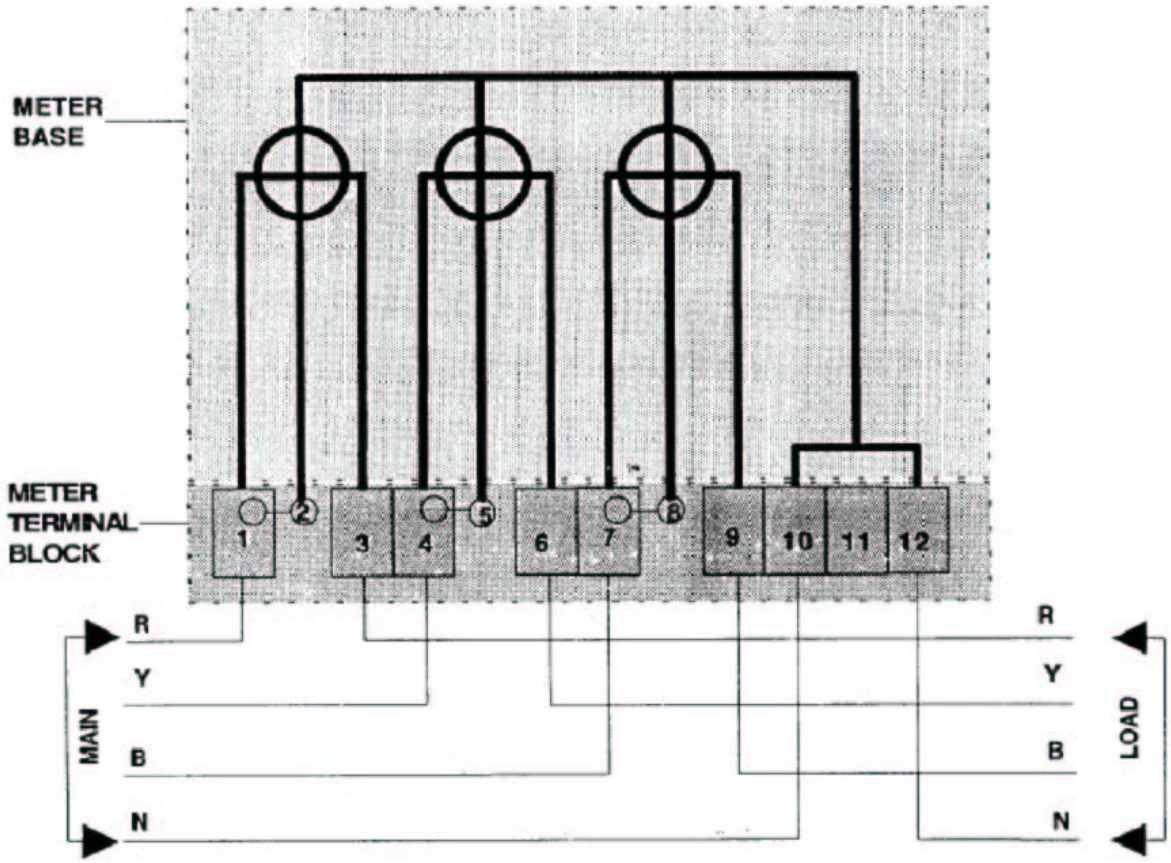
FRACTION DIVISION ON ONE DIGIT
ROLLER OF KWH METER REGISTER

FIGURE NO.
SEC/KWH-02



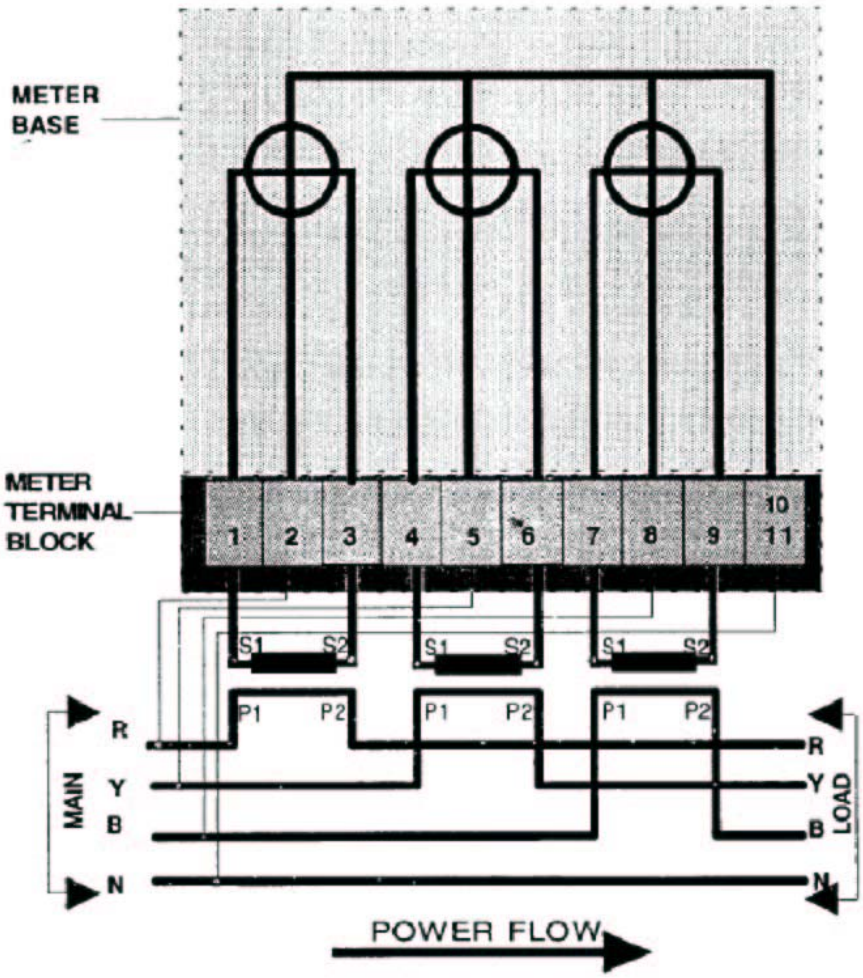
ROTOR OF THE KWH METER

FIGURE NO.
SEC/KWH-03



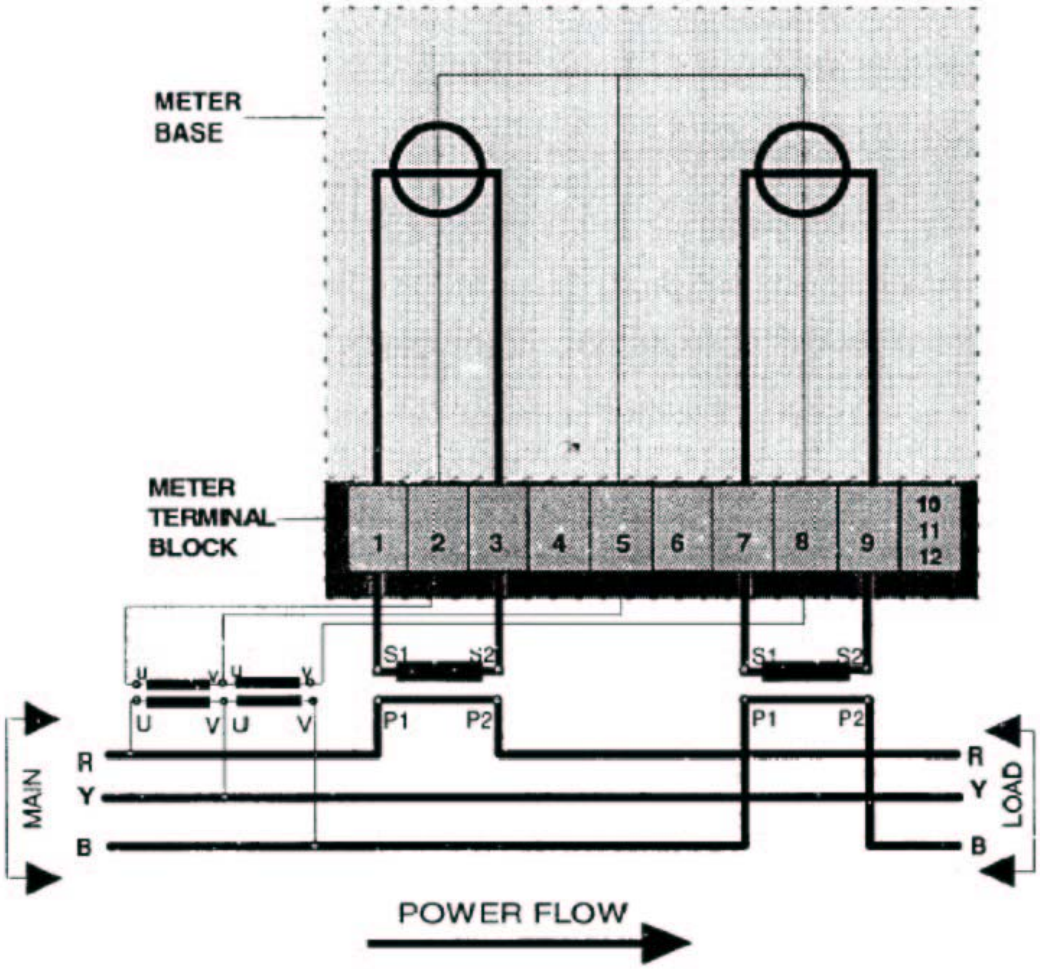
CONNECTION ARRANGEMNT FOR
THREE PHASE FOUR WIRE
WHOLE CURRENT 400/230/133 V
KWH METERS

FIGURE NO.
SEC/KWH-04



CONNECTION ARRANGEMNT FOR
THREE PHASE FOUR WIRE
CT OPERATED 400/230/133 V
KWH METERS

FIGURE NO.
SEC/KWH-05



CONNECTION ARRANGEMNT FOR THREE PHASE THREE WIRE CT, VT OPERATED 110 V KWH METERS

FIGURE NO.
SEC/KWH-06