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MAHAVEER

# S V ENGINEERING COLLEGE

Karakambadi road, Tirupati-517507, A.P
(Affiliated to J.N.T.U, Anantapur)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## (15A02507) ELECTRICAL MEASUREMENTS LAB

**Year: B.Tech. III - I Sem. (EEE)**

## LIST OF EXPERIMENTS

**The following experiments are required to be conducted as compulsory experiments:**

1. Calibration and Testing of Single Phase Energy Meter
2. Calibration of Dynamometer Power Factor Meter
3. Crompton D.C. Potentiometer – Calibration of PMMC Ammeter and PMMC Voltmeter
4. Kelvin's Double Bridge – Measurement of Resistance – Determination of Tolerance.
5. Measurement of % Ratio Error and Phase Angle of Given C.T. by Comparison.
6. Schering Bridge & Anderson Bridge.
7. Measurement of 3 Phase Reactive Power with Single-Phase Wattmeter.
8. Measurement of Parameters of a Choke Coil Using 3 Voltmeter and 3 Ammeter Methods.

**In addition to the above eight experiments, at least any two of the experiments from the following list are required to be conducted:**

9. Optical Bench – Determination of Polar Curve Measurement of MHCP of Filament Lamps
10. Calibration LPF Wattmeter – by Phantom Testing
11. Measurement of 3 Phase Power with Two Watt Meter Method (Balanced & Un balanced).
12. Dielectric Oil Testing Using H.T. Testing Kit
13. LVDT and Capacitance Pickup – Characteristics and Calibration
14. Resistance Strain Gauge – Strain Measurements and Calibration
15. Transformer Turns Ratio Measurement Using A.C. Bridge.

circuit diagram:

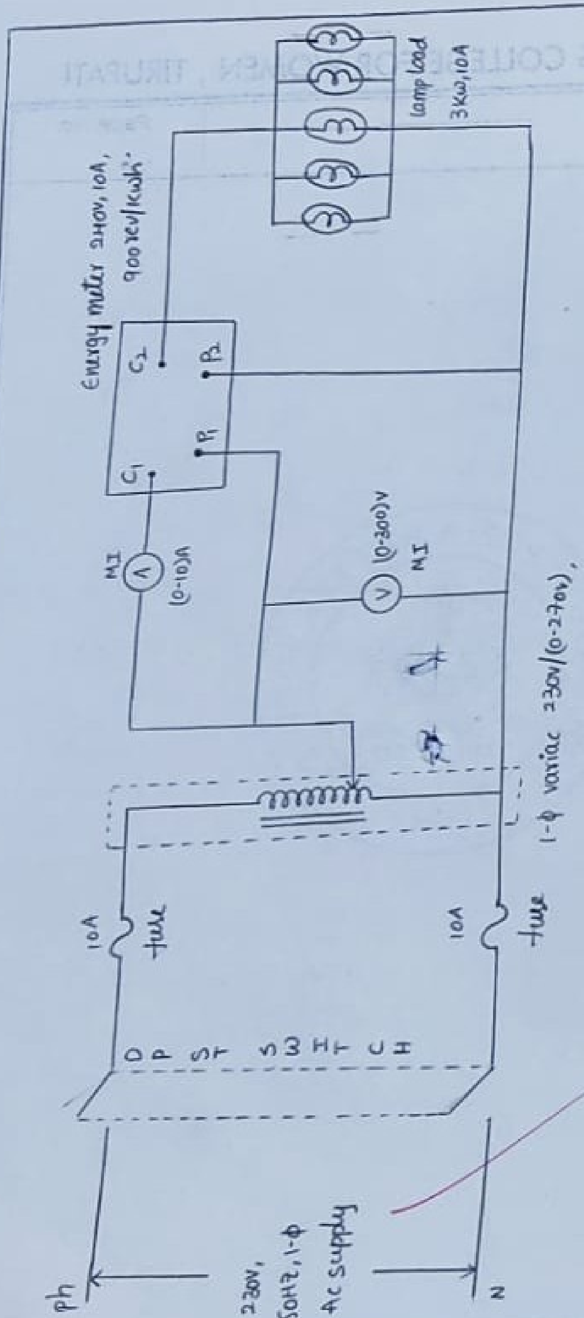


fig: circuit diagram for calibration of energy meter by phantom loading.





# CALIBRATION OF ENERY METER BY PHANTOM LOADING

**Aim:**

To calibrate single phase energy meter and obtain percentage error from apparent energy and actual energy.

**Apparatus:**

| Sl.No | Equipment | Range | Type | quantity |
|---|---|---|---|---|
| 1. | Ammeter | (0-10)A | MI | 1 NO. |
| 2. | voltmeter | (0-300)V | MI | 1 NO. |
| 3. | wattmeter | 300V/10A | UPF | 1No. |
| 4. | Energy meter | 240V,10A, 900rev/kwh | Induction | 1 NO. |
| 5. | 1-ϕ variac | 230V/(0-230)V | - | 1 NO |
| 6. | Stop clock | - | Digital | 1 NO. |
| 7. | connecting wires | - | - | required some |

## Tabular column:

| Sl.No | voltage (V) | current (A) | Time for 10 revolutions (sec) | | Actual energy(VIT) (Kwh) | Total Energy recorded (Kwh) | % error |
|---|---|---|---|---|---|---|---|
| | | | sec | hrs | | | |
| 1. | 220 | 1 | 208 | 0.057 | 0.0125 | 0.0111 | 12.97 |
| 2. | 218 | 2 | 103 | 0.028 | 0.0122 | 0.0111 | 9.909 |
| 3. | 216 | 3.6 | 53 | 0.0147 | 0.01088 | 0.0111 | -1.98 |
| 4. | 216 | 4.6 | 41 | 0.0113 | 0.0109 | 0.0111 | -1.62 |

## formulae:

Total energy = No. of pulses/900

$$\% \text{ Error} = \frac{\text{Actual energy} - \text{Total energy}}{\text{Total energy}} \times 100$$

## Calculations:

1. Total energy: No. of pulses/900

= 10/900

= 0.0111 kwh

$\boxed{\text{Total energy} = 0.0111 \text{ kwh}}$



## theory:

Induction type of energy meters are universally used for measurement of energy in domestic and industrial a.c circuits. Induction type of meters possesses lower friction and higher torque/ weight ratio. Also they are inexpensive and accurate and retain their accuracy over a wide range of loads and temperature conditions. the Driving system of the meter consists of two electro magnets. the core of these electromagnets is madeup of silicon steel laminations. the coil of one of the electromagnetic is excited by the load currents. this coil is called the "current coil" the coil of second electromagnet is connected across the supply voltage. this coil is called the "pressure coil". consequently . the two electromagnets are known as series and shunt magnets respectively. copper shading bands are provided on the central limb. the position of these banks is adjustable the function of these bands is to bring the flux produced by the shunt magnet exactly in quadrature with the applied voltage.

5. connections are changed for obtaining different power factor and for different current setting time taken by the energy meter for 20 revolutions is noted. Apparent energy and % Error are calculated.

Result :

Hence the single phase energy meter is calibrated and percentage error from apparent energy and actual energy are obtained.

20/7/18

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$$\% \text{ Error} = \frac{\text{Actual energy} - \text{Total energy}}{\text{Total energy}} \times 100$$

$$= \frac{0.0125 - 0.0111}{0.0111} \times 100$$

$$= 12.97\%$$

$$\boxed{\% \text{ Error} = 12.97\%}$$

2. $$\% \text{ Error} = \frac{\text{Actual energy} - \text{Total energy}}{\text{Total energy}} \times 100$$

$$= \frac{0.0122 - 0.0111}{0.0111} \times 100$$

$$= 9.909\%$$

$$\boxed{\% \text{ Error} = 9.909\%}$$

3. $$\% \text{ Error} = \frac{\text{Actual energy} - \text{Total energy}}{\text{Total energy}} \times 100$$

$$= \frac{0.01088 - 0.0111}{0.0111} \times 100$$

$$= -1.98\%$$

$$\boxed{\% \text{ Error} = -1.98\%}$$



Moving system consists of an alluminium disc mounted on a light alloy shaft. this disc is positioned in the air gap between series and shunt magnets. Braking system is a permanent magnet positioned near the edge of the alluminium disc moves in the field of this magnet and thus provided a braking torque. the position of permanent magnet is adjustable.

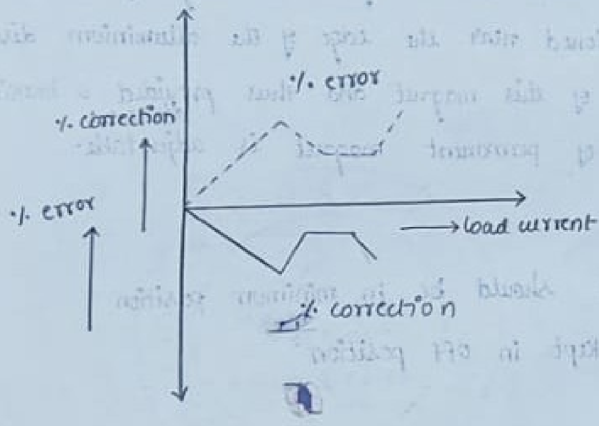
Precautions:

1. 1-$\phi$ variac should be in minimum position
2. load is kept in off position

Procedure:

1. connections are made as shown in circuit diagram.
2. DPST switch is closed and supply is switched ON.
3. By adjusting the booster transformer rated voltage is applied to the pressure circuit
4. current is applied by using auto-transformer and maintained at certain value for time taken for 20 revolutions of energy meter.

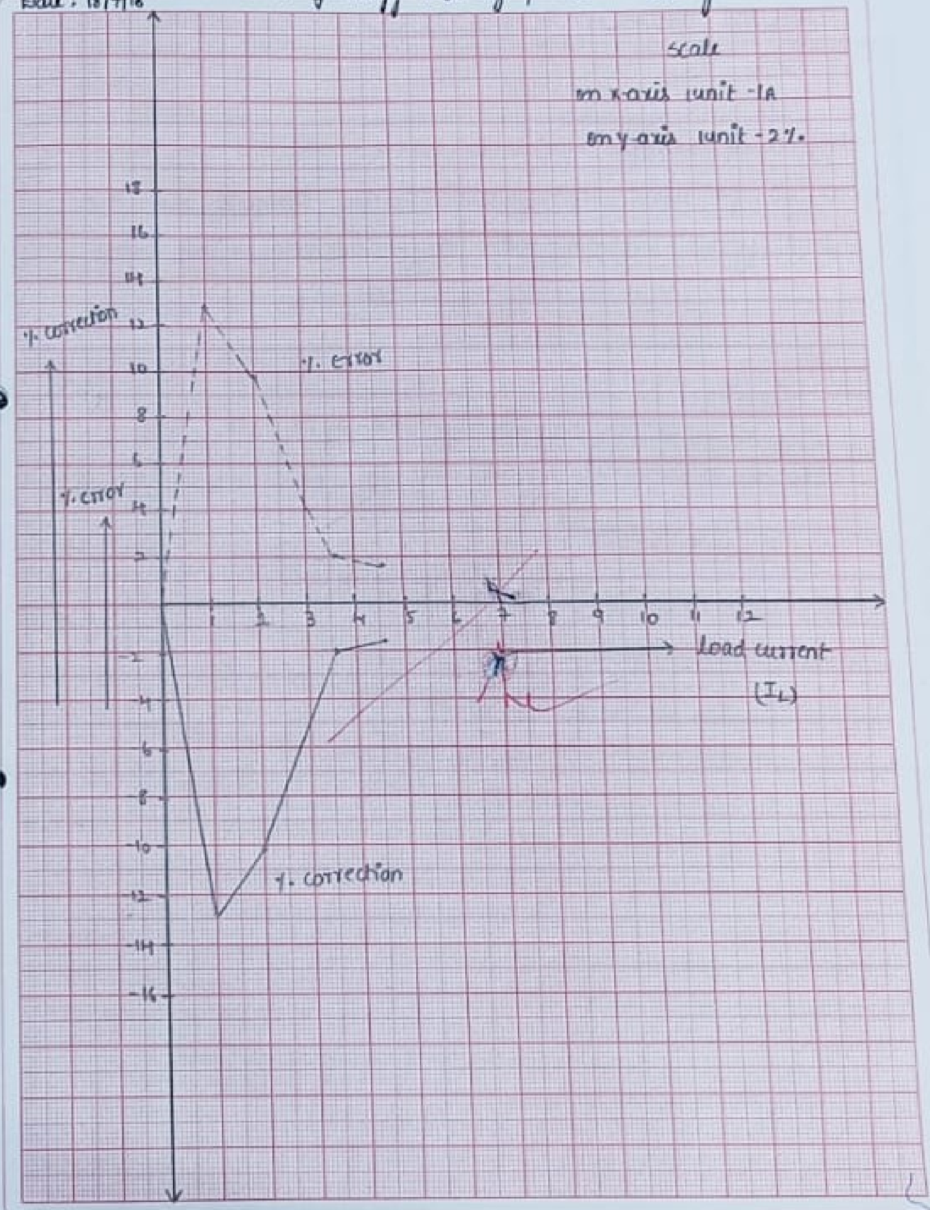
## Model Waveforms:




EXP NO: 02
Date: 18/7/18

calibration of energy meter by phantom loading





## circuit diagram:

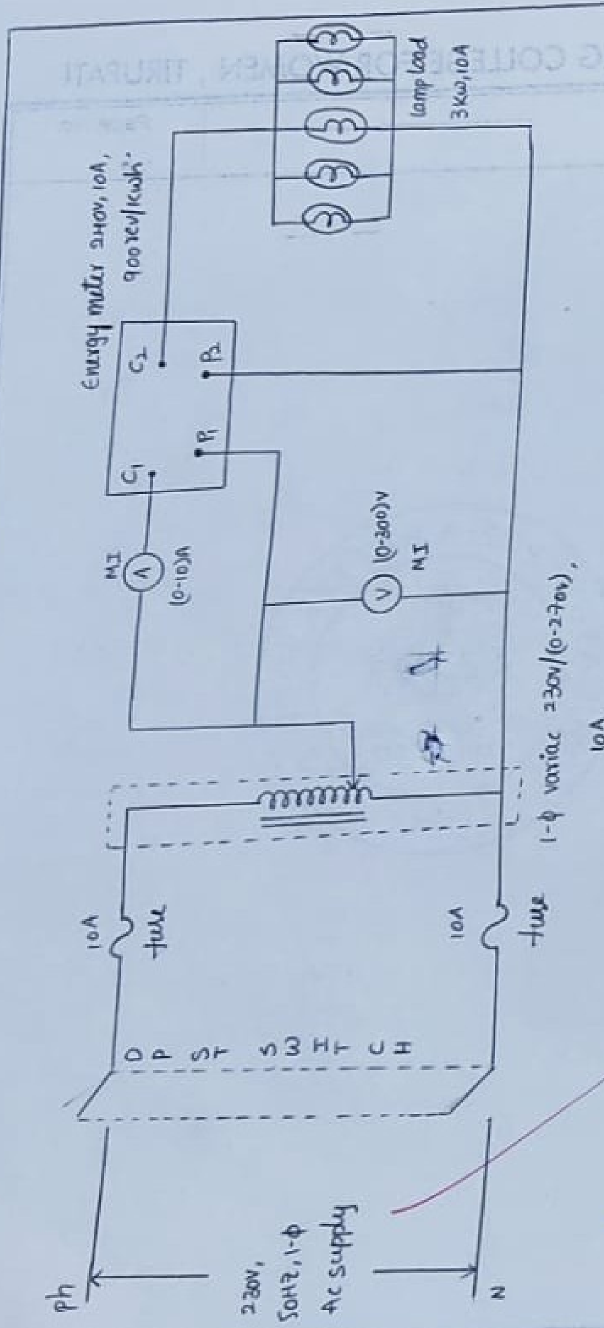



fig: circuit diagram for calibration of energy meter by phantom loading.



# CALIBRATION OF ENERY METER BY PHANTOM LOADING

**Aim:**

To calibrate single phase energy meter and obtain percentage error from apparent energy and actual energy.

**Apparatus:**

| Sl·No | Equipment | Range | Type | Quantity |
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| 4. | Energy meter | 240V,10A, 900rev/kwh | Induction | 1 No. |
| 5. | 1-ϕ variac | 230V/(0-230)V | - | 1 No |
| 6. | Stop clock | - | Digital | 1 No. |
| 7. | connecting wires | - | - | required some |

Theoretical calculations

3-Ammeter method:

(i) power factor $(\cos\theta) = \dfrac{I_S^2 - I_R^2 - I_L^2}{2 I_R I_L}$

$$= \frac{(0.7)^2-(0.4)^2-(0.4)^2}{2\times0.4\times0.4}$$

$$= 0.531$$

(ii) Resistance $(R) = \dfrac{V\cos\theta}{I_L}$

$$= \frac{188\times0.531}{0.4}$$

$$= 249.57\,\Omega$$

(iii) Inductive reactance $(X_L) = \dfrac{V\sin\theta}{I_L}$

$$= \frac{188\times0.847}{0.4}$$

$$= 398.23\,\Omega$$

(iv) Inductance $L = X_L/2\pi f$

$$= \frac{398.23}{2\times\pi\times50}$$

$$= 1.267\text{ H}$$

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Exp. No. :

Date :

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Result :

| | 3-Ammeter method | 3-voltmeter method |
|---|---|---|
| Resistance of a coil R | 249.57Ω | 366.45Ω |
| Inductance of a coil L | 1.267 H | 1.065 H |
| power factor | 0.531 | 0.738 |

Hence the parameters of a choke coil by using 3 voltmeter and 3-Ammeter method are measured.

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(ii) 3-voltmeter method:

Power factor $\cos\theta = V_S^2 - V_R^2 - V_L^2 / 2V_RV_L = 0.738$

Resistance $= \frac{V_L \cos\theta}{I} = 366.45\Omega$

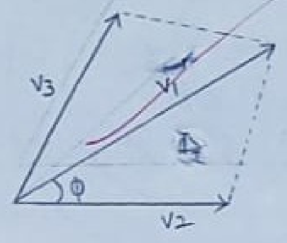
Inductive reactance of the coil $= X_L = \frac{V_L \sin\theta}{I_1} = 334.82\Omega$

Inductance $= \frac{X_L}{2\pi f} = 1.065H$

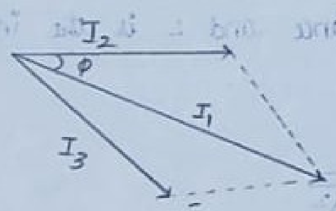
where f is the frequency of supply in hertz = 50Hz

phasor Diagrams:

3-voltmeter method:




3-Ammeter method:






Procedure:

1. Make the connections as per the circuit shown in figure 1.
2. Intially keep the autotransformer in minimum position close supply DPST switch
3. vary the applied voltage by varying the auto-transformer until rated current flows through the choke coil.
4. Note down the readings of all the meters.
5. Make connections as per the circuit shown in figure 2
6. Repeat steps 2,3,4 and 5
7. Draw the phasor diagram for both the methods.

Precautions:

1. Avoid loose connections
2. keep autotransformer in minimum position before closing supply DPST.
3. Readings are to be taken without parallex error.

# S V ENGINEERING COLLEGE FOR WOMEN

## DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING [2017-21 Batch]

Name of the Lab : Electrical Measurements (15A02507) Year : III-I Brancl EEE Section: A Name of the faculty:

| S.NO | Roll.NO | 1 | | | | | 2 | | | | | 3 | | | | | 4 | | | | | 5 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | V | O | R | T | A | V | O | R | T | A | V | O | R | T | A | V | O | R | T | A | V | O | R | T |
| 1 | 179E1A0201 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 9 | 26 | 4 | 4 | 9 | 9 | 26 | 4 | 4 | 9 | 10 | 27 |
| 2 | 179E1A0202 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 4 | 5 | 10 | 10 | 29 |
| 3 | 179E1A0203 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 10 | 10 | 28 |
| 4 | 179E1A0204 | 4 | 4 | 9 | 10 | 27 | 5 | 4 | 9 | 10 | 28 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 10 | 10 | 28 | 5 | 5 | 9 | 9 | 28 |
| 5 | 179E1A0205 | 4 | 4 | 8 | 9 | 25 | 4 | 4 | 8 | 8 | 24 | 4 | 4 | 9 | 10 | 27 | 3 | 3 | 8 | 8 | 22 | 3 | 3 | 8 | 8 | 22 |
| 6 | 179E1A0206 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 10 | 10 | 28 | 5 | 5 | 10 | 10 | 30 |
| 7 | 179E1A0207 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 9 | 10 | 29 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 |
| 8 | 179E1A0208 | 5 | 3 | 10 | 10 | 28 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 5 | 4 | 10 | 10 | 29 |
| 9 | 179E1A0209 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 |
| 10 | 179E1A0210 | 4 | 4 | 9 | 10 | 27 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 9 | 10 | 28 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 9 | 10 | 27 |
| 11 | 179E1A0211 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 |
| 12 | 179E1A0212 | 2 | 2 | 6 | 5 | 15 | 2 | 2 | 6 | 5 | 15 | 2 | 2 | 5 | 5 | 14 | 2 | 2 | 6 | 5 | 15 | 2 | 2 | 5 | 5 | 14 |
| 13 | 179E1A0213 | 4 | 4 | 9 | 10 | 27 | 4 | 3 | 9 | 9 | 25 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 10 | 9 | 27 |
| 14 | 179E1A0214 | 5 | 4 | 9 | 9 | 27 | 4 | 4 | 10 | 10 | 28 | 4 | 3 | 9 | 9 | 25 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 10 | 27 |
| 15 | 179E1A0215 | 5 | 5 | 9 | 9 | 28 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 10 | 27 | 5 | 5 | 10 | 10 | 30 |
| 16 | 179E1A0216 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 9 | 10 | 29 | 5 | 5 | 10 | 10 | 30 |
| 17 | 179E1A0217 | 5 | 4 | 9 | 9 | 27 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 9 | 10 | 27 | 5 | 5 | 9 | 9 | 28 | 4 | 3 | 9 | 9 | 25 |
| 18 | 179E1A0218 | 4 | 5 | 9 | 9 | 27 | 4 | 4 | 9 | 10 | 27 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 10 | 10 | 28 | 3 | 4 | 9 | 9 | 25 |
| 19 | 179E1A0219 | 3 | 3 | 8 | 10 | 22 | 3 | 3 | 8 | 8 | 20 | 3 | 3 | 9 | 8 | 23 | 5 | 5 | 10 | 10 | 30 | 3 | 3 | 8 | 8 | 22 |
| 20 | 179E1A0221 | 4 | 5 | 10 | 10 | 29 | 4 | 5 | 10 | 10 | 29 | 4 | 4 | 10 | 10 | 28 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 |
| 21 | 179E1A0222 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 10 | 10 | 28 | 5 | 4 | 10 | 10 | 29 |
| 22 | 179E1A0223 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 4 | 5 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 |
| 23 | 179E1A0224 | 4 | 4 | 10 | 10 | 28 | 4 | 4 | 9 | 10 | 27 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 9 | 10 | 27 | 5 | 4 | 9 | 9 | 27 |
| 24 | 179E1A0225 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 | 4 | 5 | 10 | 10 | 29 | 5 | 4 | 10 | 10 | 29 |
| 25 | 179E1A0226 | 5 | 5 | 10 | 10 | 30 | 4 | 4 | 9 | 9 | 26 | 5 | 5 | 10 | 10 | 30 | 4 | 3 | 9 | 9 | 25 | 5 | 4 | 9 | 9 | 27 |
| 26 | 179E1A0227 | 5 | 4 | 9 | 9 | 27 | 4 | 4 | 10 | 9 | 27 | 4 | 4 | 9 | 9 | 26 | 4 | 4 | 9 | 9 | 26 | 5 | 3 | 9 | 9 | 26 |
| 27 | 179E1A0228 | 5 | 4 | 10 | 10 | 29 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 10 | 10 | 30 | 5 | 5 | 10 | 10 | 30 | 5 | 4 | 10 | 10 | 29 |
| 28 | 179E1A0229 | 4 | 4 | 9 | 10 | 28 | 5 | 4 | 9 | 10 | 28 | 4 | 4 | 9 | 10 | 27 | 4 | 4 | 9 | 9 | 26 | 5 | 5 | 10 | 10 | 30 |
| 29 | 179E1A0230 | 5 | 4 | 10 | 10 | 29 | 5 | 5 | 9 | 10 | 29 | 4 | 4 | 10 | 10 | 28 | 5 | 4 | 9 | 9 | 27 | 5 | 5 | 10 | 10 | 30 |