

THE A-C WATT - HOUR METER OF FUJI DENKI SEIZO K.K.

I. INTRODUCTION

We have a pleasure of making a brief introduction in this article on the several types of the watt-hour meter which are, at present, manufactured under the new mass production system and the scientific factory managements by our Fuji Denki Seizo K.K., putting together with the accumulated fruits of its laboured studies toward the improvement of the various technical skills for a long time. Those meters are not only satisfied with all the requirements of the Japanese Industrial Standards JIS C 1210~1213, but also are in accordance with the American Standard Code—the American Standards Association, May 5, 1941, and the British Standard Specification, B.S. 37, 1952, regarding its main characteristics.

II. A-C INDUCTION WATT-HOUR METERS AND AUXILIARY APPARATUS

- | | |
|--|----------------------------|
| (1) Single phase watt-hour meter | Type E-71 |
| (2) Three phase three wire meter | Type D-17 |
| (3) Three phase four wire meter | Type D-28 |
| (4) Precision meters, 3-phase, 3-wire | Type D-16 |
| (5) Summation metering equipment | SUMI-4K |
| (6) Printing watt-hour meter | D-16KI DZ-1 |
| (7) Var-hour meter | Type D-16BR
Type D-24BR |
| (8) Time switch | Type U2AZ
Type U3AZ |
| (9) Maximum and minimum volt-meter | Type VH-1 |
| (10) Maximum current indicator | Type AH-4 |
| (11) Split core type current transformer | Type ST-1 |

1. Single phase watt-hour meters, Type E-71

This type of the single phase two wire is applied for the current up to 100 amps., the voltage up to 460 volts, and the frequency of 50 or 60 cycles. For the currents more than 100 amps., the 5 amps. meter and current transformers are adopted; and for the voltage exceeding 460 volts, the 110 volts meter and potential transformers are put to use.

1) Features

(1) The Variation of error of the meter is very little for wide change of the load current, so that the computation may be obtained with accuracy.

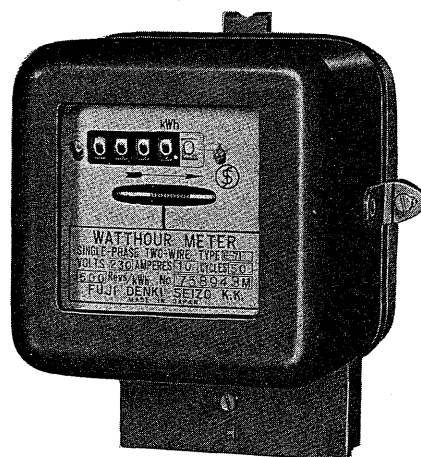


Fig. 1. E-71

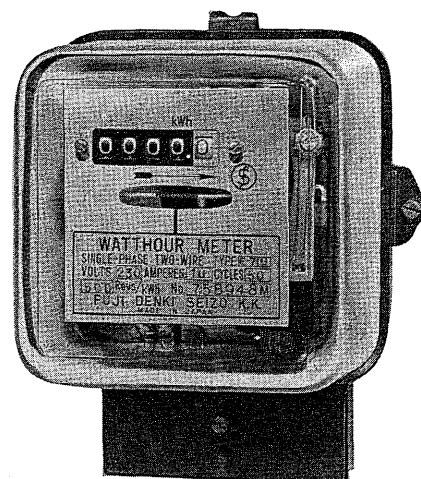


Fig. 2. E-71G

(2) The Number wheel for the counting device is made of aluminium alloy plate with a light weight and is sufficiently stabilized for ageing.

(3) Even for several characteristics at the low power factor, this meter shows and keeps good character.

(4) The Braking magnet is made of a small size and light weight MK steel, with a large coercive force, and stable for ageing.

(5) Because of both a small specific constant of the meter itself and a light weight of its revolving parts, this meter keeps a high permanence factor.

(6) With a perfect weather-proof structure, and rich in a quake-proof and anti-shock properties, this meter is very solid electrically and mechanically.

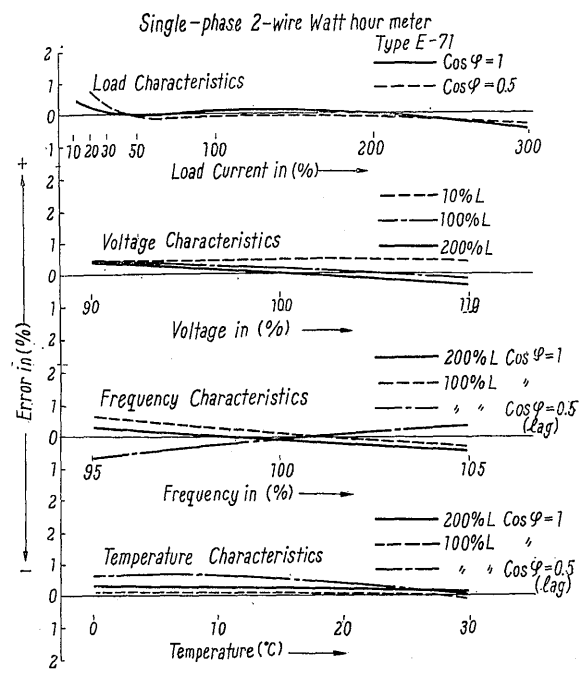


Fig. 3. Characteristics curve

- 2) Technical data (E-71)
- (1) Starting current :
below 0.8% of rated full load
 - (2) Accuracy at rated voltage and rated frequency
for 10 ~ 100% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
for 100 ~ 200% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
for 200 ~ 300% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
 - (3) Self-consumption
in pressure circuit : about $1 \times 0.7 \sim 0.9$ W
or $1 \times 3.04 \sim 3.67$ VA
in main current coils
3 ~ 10 amps. sizes : about 0.4 ~ 0.5 W
or 0.61 ~ 0.68 VA
in main current coils
20 ~ 30 amps. sizes : about 0.65 W
or 0.7 ~ 0.72 VA
in main current coils
50 amps. sizes : about 1.25 W
or 1.44 VA
in main current coils
100 amps. sizes : about 2.68 W
or 3.54 VA
5 amps. size for transformer connection :
about 0.41 W
or 0.61 VA
 - (4) Average torque at rated full load
3 ~ 30 amps. sizes : about 3.75 gr-cm
50 ~ 100 amps. sizes : about 6.25 gr-cm
 - (5) Effect of temperature at power factor 1.0 :
within 0.5% for each 10°C
 - (6) Weight of rotor : about 18.8 gr

- (7) Speed at rated full load
3 ~ 30 amps. sizes : within 20 rpm
50 ~ 100 amps. sizes : within 25 rpm
- (8) Net weight of meter
3 ~ 30 amps. sizes : approx. 1.42 kgr
50 ~ 100 amps. sizes : approx. 2.19 kgr
- (9) Overload capacity
3 ~ 10 amps. sizes : 300% continuously
20 amps. size : 200% continuously
30 ~ 50 amps. sizes : 150% continuously
100 amps. size : 130% continuously

2. Three phase three wire meters,
Type D-17

This type is applied for the currents up to 100 amps., for the voltage up to 460 volts and with the frequency of 50 or 60 cycles. In case of the currents exceeding 100 amps., the 5 amps. meter and current transformers are adopted; and for the voltage of more than 460 volts, the 110 volts meter and potential transformers are put to use.

1) Features

- (1) The meter of the rated currents up to 10 amps. is to bear sufficiently the applying of a continuous 300% overload current, and its variation of error is limited within a very narrow range. Besides, the overload characteristics are guaranteed up to 400% of full load current.
- (2) With effective function of the temperature compensating device, the variation of error is limited within a trifling range for variation of ambient temperature.
- (3) The meter is processed with necessary treatments in order to stand satisfactory for the outdoor use.



Fig. 4. D-17

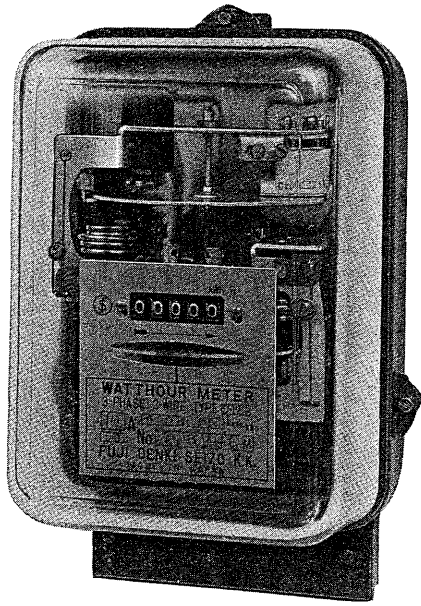


Fig. 5. D-17G

(4) The Braking magnet is made of a strong, small sized, and light weight MK steel with a precipitation hardening process, so that the durability of the meter is kept very large and long.

(5) Its driving force of revolution is very large and the balance and stability of the meter is kept at the very high level.

(6) The indicating figures of the counting device is marked so large that their reading is made in the quite easy manner.

(7) The error adjusting device is of a micrometer type with a slight mutual interference and easy adjustment.

(8) Its structure is rich in a quake-proof and anti-shock properties, solid electrically and mechanically, and able to bear the continuous use for a long duration.

2) Technical data (D-17)

- (1) Starting current :
below 0.8% of rated full load
- (2) Accuracy at rated voltage and rated frequency
fro 10~100% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
for 100~200% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
for 200~300% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
- (3) Self-consumption
in pressure circuit : about $3 \times 0.75 \sim 0.8$ W
or $3 \times 2.7 \sim 3.1$ VA
in main current coils
3~10 amps. sizes : about 0.75 W
or 0.81~0.92 VA

in main current coils

20~30 amps. sizes : about 0.85 W
or 0.75~0.76 VA

in main current coils

50 amps. size : about 1.25 W
or 1.44 VA

in main current coils

100 amps. size : about 2.68 W
or 3.54 VA

5 amps. size for transformer connection :

about 0.75 W
or 0.88 VA

- (4) Average torque at rated full load
3~30 amps. : about 8.0 gr-cm
50~100 amps. : about 10.6 gr-cm
- (5) Effect of temperature at power factor 1.0 :
within 0.5% for each 10°C
- (6) Weight of rotor : about 59 gr.
- (7) Speed at rated full load
3~100 amps. sizes : within 8.67 rpm
- (8) Net weight of meter
3~30 amps. sizes : approx. 2.8 kgr
50~100 amps. sizes : approx. 3.5 kgr
- (9) Overload capacity
3~10 amps. sizes : 300% continuously
20 amps. size : 200% continuously
30~50 amps. sizes : 150% continuously
100 amps. size : 130% continuously

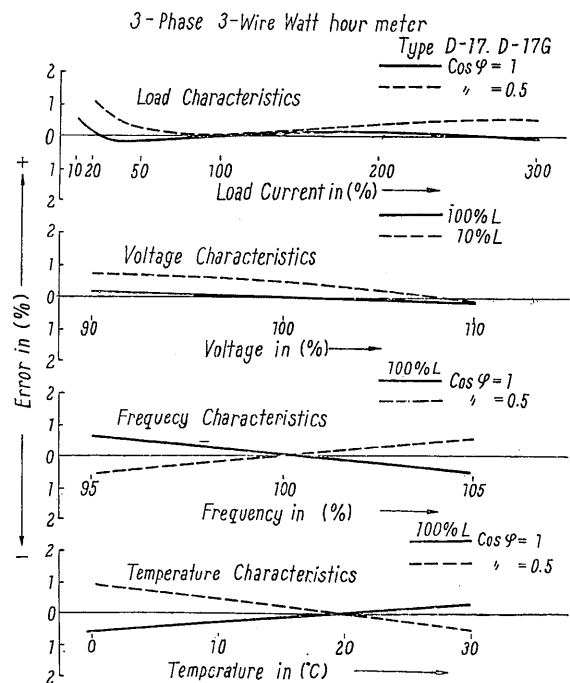


Fig. 6. Characteristics curve

3. Watt-hour meters, Type D-28 with 3 elements

1) Applications

For three phase installations with four conductors

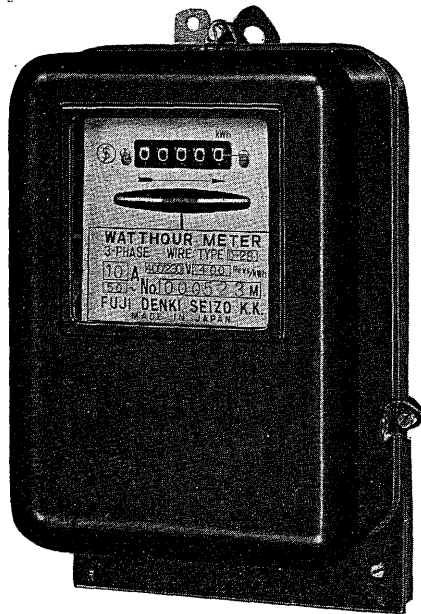


Fig. 7. D-28

(including neutral) or three conductors, with inductive or non-inductive loads, with balanced or unbalanced phases, up to $3 \times 260/450$ volts and up to 100 amps. for a frequency 50 or 60 cycles.

For currents over 100 amps. and voltages up to $3 \times 260/450$ volts a 5 amps. meter should be used in conjunction with 3 current transformers. For voltage over $3 \times 260/450$ volts a 5 amps. meter for $3 \times 110/190$ or $100/173$ volts should be used in conjunction with 3 current transformers and 3 single phase potential transformers. The primary voltage of the latter should be the voltage between one main conductor and the neutral (star connection). The neutral conductor can be led into the meter or tapping connection made.

The meters are provided with compensation for temperature variation.

2) Technical data

- (1) Starting current :
below 0.8% of rated full load
- (2) Accuracy at rated voltage and rated frequency with balanced load
for 10~100% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
for 100~300% of rated full load
at power factor 1.0 and 0.5 : $\pm 2.5\%$
- (3) Self-consumption
in pressure circuit : about 3×0.9 W
or $3 \times 3.04 \sim 3.67$ VA
in main current coils
3~10 amps. sizes :
about $3 \times (0.4 \sim 0.5)$ W
or $3 \times (0.61 \sim 0.68)$ VA

in main current coils

20~30 amps. sizes : about 3×0.65 W
or 3×0.72 VA

in main current coils

50 amps. size : about 3×1.25 W

in main current coils

100 amps. size : about 3×2.68 W

5 amps. size for transformer connection :

about 3×0.41 W
or 3×0.61 VA

- (4) Average torque at rated full load
30 amps. size : about 12.5 gr-cm
50 amps. size : about 20 gr-cm
- (5) Effect of temperature at power factor 1.0 :
within $\pm 0.5\%$ for each 10°C
- (6) Weight of rotor : about 48.5 gr
- (7) Speed at rated full load
30 amps. size : within 23 rpm
50 amps. size : within 46 rpm
- (8) Net weight of meter
30 amps. size : approx. 3.5 kgr
50 amps. size : approx. 5.4 kgr
- (9) Overload capacity
10 amps. size : 300% continuously
20 amps. size : 200% continuously
30~50 amps. sizes : 150% continuously
100 amps. size : 130% continuously

4. High precision meters, Type D-16

1) Features

(1) The meters of this type are provided with those special properties of compensating the specific properties of the attached instrument transformers, so

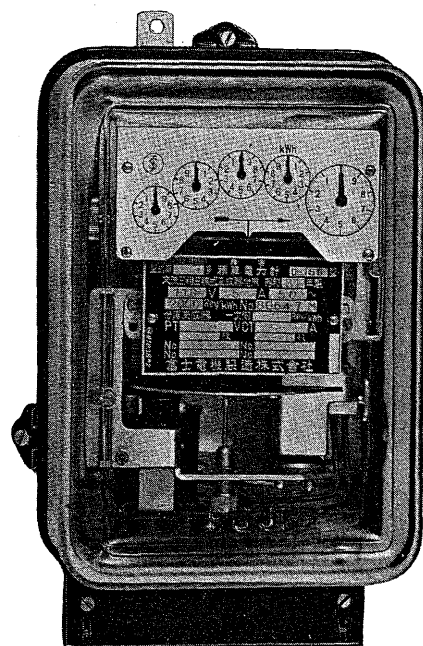


Fig. 8. D-16G

that the combined total error may be limited within a very narrow range.

(2) This meter is to stand sufficiently against the continuous 150% overload current, with a slight range of the variation of error and the overload characteristics are guaranteed up to 200% of full load current.

(3) This meter has highly qualified characteristics being fitted with the secondary temperature compensating and the overload compensating devices.

(4) The Braking magnet is made of a strong, long-durable and highly stabilized alnico steel with a precipitation hardening process, and its driving force of revolution is so large that its permanence factor may be kept very excellent.

(5) The starting current is made less than 0.25% of the rated full load.

(6) The counting device of the pointer type is very little in its friction and quite easy in its reading.

(7) Each error-adjusting device is of a micro-meter type with a slight mutual interference and easy adjustment.

(8) Its structure is rich in the quake-proof and anti-shocking properties, very solid electrically and mechanically, and is to bear the continuous use for a long duration.

2) Technical data

- (1) Starting current :
below 0.25% of rated full load
- (2) Accuracy at rated voltage and rated frequency with balanced load
for 10~100% of rated full load
at power factor 1.0 and 0.5 : $\pm 1.5\%$
for 100~150% of rated full load
at power factor 1.0 and 0.5 : $\pm 1.5\%$
- (3) Self-consumption
in pressure circuit : about 1.1~1.2 W
or 4.2~4.6 VA

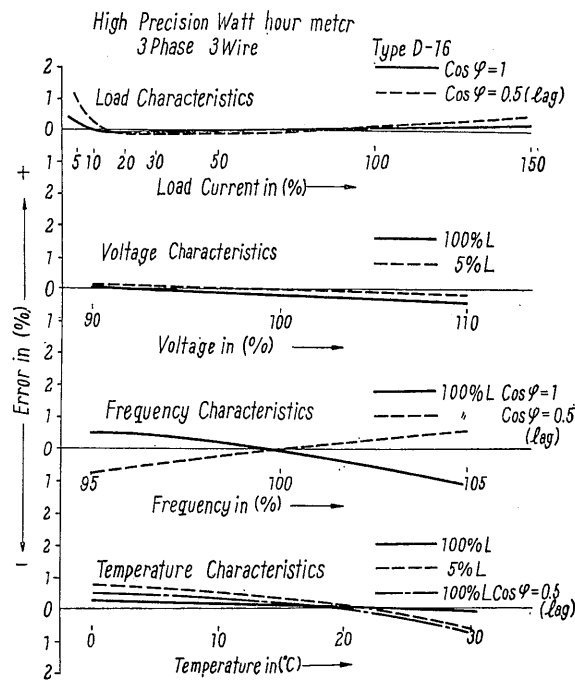


Fig. 9. Characteristics curve

5 amps. size for transformer connection :

about 2.1 W
or 4.7 VA

- (4) Average torque at full load :
about 18 gr-cm
- (5) Effect of temperature at power factor 1.0 :
within 0.3% for each 10°C
- (6) Weight of rotor :
about 44 gr
- (7) Speed at rated full load :
within 31.75 rpm
- (8) Net weight of meter :
approx. 2.75 kgr
- (9) Overload capacity :
150% continuously

(By Hujio Maruyama, Technical Div.,
Matsumoto Works)