

PRECISION ELECTRICAL INDICATING INSTRUMENTS

Electrical instruments, which we are manufacturing in perfect technical co-operation with Siemens & Halske Co. in Germany, are held in high opinion with regard to accuracy, sensitivity, robustness, elegance etc.,

Our precision instruments satisfy "Class 0.2 or 0.5" of Japanese Standards JIS-C-1102, "Class 0.1, 0.2 or 0.5" of German Standards VDE 0410/1.53 and "Class Precision" of British Standards 89:1954, as rules for electrical indicating instruments. Dimensions of instrument are small ($255 \times 196 \times$ about 130 mm) and its weight is light (2.4~3.6 kg). Many kinds of rating are prepared and different data (current consumption, voltage drop etc.) are convenient for use. Therefore, our precision instruments are well suited for special use as sub-standard and also for general use in laboratories, test rooms, meter gauging offices and schools etc.

We use two indicating methods, namely pointer instruments and light-spot instruments. The moving systems of the **pointer instruments** are supported by special steel pivots in the jewel bearings. The pivots and bearings are finished with the greatest precision in order to reduce errors due to friction. The **light-spot instruments** are the modern and unique instruments, developed by Siemens & Halske Co.. The light beam runs inside the case (see Fig. 3). Due to the prolongation of the light beam to a length of 300 mm by repeated reflection, the high sensitivity and low power consumption are attained.

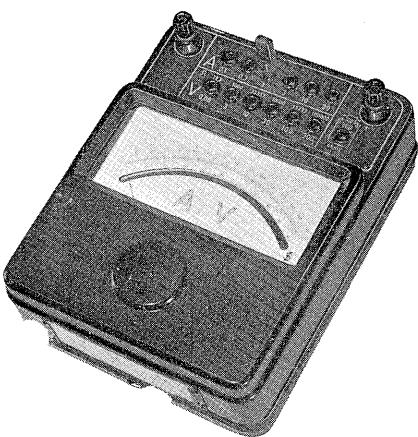


Fig 1. Pointer instrument

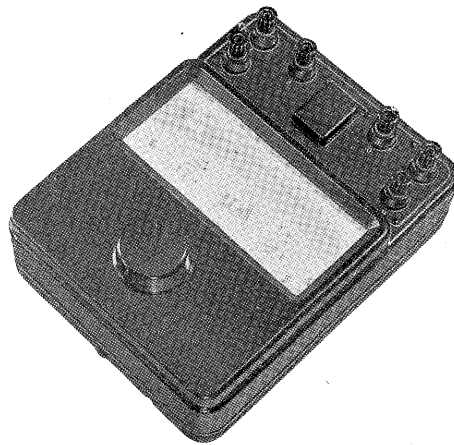


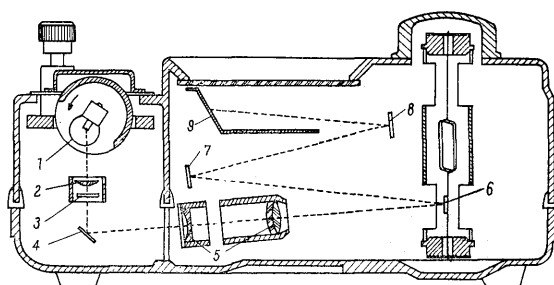
Fig. 2. Light-spot instrument

The moving systems of the light-spot instruments are supported by **spannbands** on the spring plates, so that friction error cannot occur. These instruments are vibration and shock-proof to a high degree.

The standard kinds of our precision instruments are listed as follows. (See Table 1, 2)

Type **LM** volt-and ammeters for D.C. are equipped with classic moving-coil elements, but have the highest accuracy such as Class 0.1 or 0.2.

Type **LS** are volt-and ammeters with unique moving-iron elements, which are eccentrically placed in the elliptic field coil (see Fig. 4). Its accuracy



1. Lamp 2. Convex lens 3. Circular diagram with reading mark 4. 7 and 8 Reflecting mirrors 5. Lenses 6. Mirror of moving system. 9. Scale

Fig. 3. Optical system of light-spot instrument

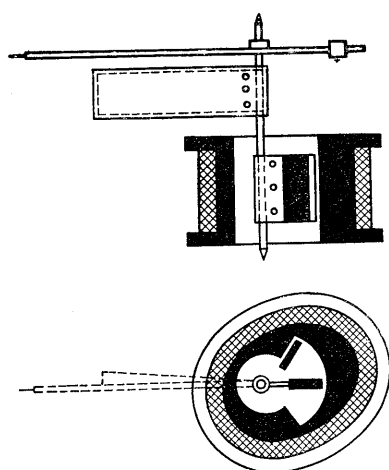


Fig. 4. Model diagram of measuring element of type LS

is Class 0.2 for both A.C. and D.C.. The indicating difference between A.C. and D.C. is less than $\pm 0.05\%$ of full-scale deflection. The frequency range extends from 15 to 50 to 150 c/s. The error due to stray fields (5 Oersteds) is restricted to $\pm 0.5\%$ of the indication. The influence due to change in ambient temperature is compensated with ammeters to $\pm 0.07\%$, with voltmeters it is lower than $\pm 0.1\%$ per 10°C .

The **LML** volt- and ammeters for D.C. have the spannband-supported moving-coil elements with core magnet (see Fig. 5). The main features are: High

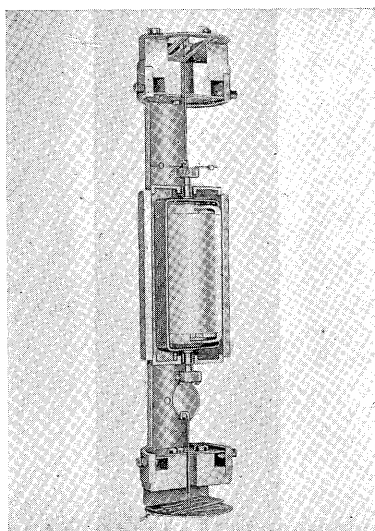


Fig. 5. Sectional diagram of measuring element of type LML

sensitivity, low consumption and independence on stray fields. Accuracy is specified for Class 0.2 and 0.5 in connection with sensitivity.

Type **LSL** volt-and ammeters for A.C. are the modernest instruments and are equipped with the spannband-supported moving-iron elements. These instruments reach the region of the rectifier-type instruments, regarded as high sensitivity and low power consumption. Accuracy is Class 0.5. The frequency range extends from 15 to 50 to 500 c/s. The error due to stray fields (5 Oersteds) is restricted to $\pm 0.1\%$.

Type **LDL** wattmeters for A.C. and D.C. are equipped with the spannband-supported ironless astatic electrodynamic elements (see Fig. 6). The frequency range is wide as shown in List. In general wattmeters ($\cos \varphi = 1$ or 0.5), accuracy is

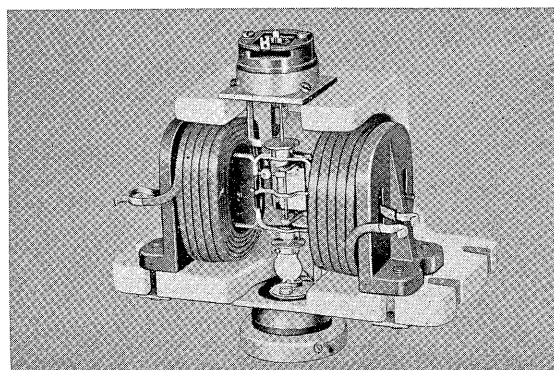


Fig. 6. Measuring element of type LDL

Class 0.1 or 0.2, difference of A.C. and D.C. is less than 0.02% , power factor error (at 0.5 power factor) is less than 0.03% , error due to stray fields of 5 Oersteds is only $\pm 0.1\%$ and error due to change in ambient temperature is only 0.05% per 10°C . The power consumption is only 0.3 VA. Furthermore, we are manufacturing the special wattmeters for rated power factor 0.1 or 0.05, as Class 0.5, which are suited for iron loss and $\tan \delta$ measurement etc.

Table 1. Precision Instrument

Type and Use				Standard Rating			Accuracy Class	Consumption				
								Current circuit	Voltage circuit			
Pointer type (Pivot-supported)	LM	Moving-coil	D.C. Voltmeter & Ammeter	45 mV 3 V			0.1 or 0.2	—	4.5 mA 3 mA			
				0.1-0.3-1-3-10-30 A			0.2	70...100mV	4.5 mA 4.5 mA 3 mA 3 mA			
				45 mV 60 mV 3 V 10-30-100-300 V								
	LS	Moving-iron	D.C. & A.C. ¹⁾ Voltmeter & Ammeter	6 A			0.2	<1 VA ²⁾	—			
				0.03-0.06 A								
				0,12-0.24 A								
				0.6-1.2 A								
				1.2-2.4 A								
				3-6 A								
				6-12 A			0.2	—	60 mA 400-200-200mA 120-60-60 mA 60-30-30 mA			
				130 V								
				15-30-75 V								
75-150-300 V												
150-300-600 V												
Light-spot type (Spannband-supported)	LML	Moving-coil (Core magnet)	D.C. Voltmeter & Ammeter	¹ μA 3-10-30-100 μA			0.5	³ mV 8...11 mV	—			
				1-3-10-30-100 mV								
				0.3 μA 30 mV								
				1 μA 10 mV								
				3 μA 3 mV			0.5	9 mV — 3 mV — 0.9 mV — 0.3 mV — 0.3 mV — — —	10 μA — 0.3 μA — 1 μA — 3 μA — 10 μA — 30 μA — 0.08 mA			
				10 μA 1 mV								
				30 μA 0.3 mV								
				0.1-0.3-1-3-10-30 mA 10-30-100-300-1000 mV								
				LSL	Moving-iron	A.C. ³⁾ Voltmeter & Ammeter	1 mA			0.5	0.003 VA ²⁾	—
							1.5-3 mA					
	7.5-15-30 mA											
	1.5-3-7.5-15 V						0.5	—	30-15-7.5-7.5 mA 1 mA (1000 Ω/V)			
	30-75-150-300-750 V											
	LDL	Electrodynamometer (Astatic)	D.C. & A.C. Wattmeter	5 A		90 V	cos φ=1 or 0.5	0.1 or 0.2 ⁴⁾	<0.3 VA ²⁾	30 mA		
				0.1-0.2 A		90 V 180 V	cos φ=1 or 0.5	0.2 ⁴⁾				
				0.5-1 A								
				1 -2 A								
				2.5-5 A								
				5 -10 A		90, 180V	cos φ=1 or 0.5	0.5 ⁵⁾				
				0.025-0.05A								
				0.1-0.2 A								
				0.5-1 A								
				1 -1 A		90 V 180 V	cos φ=1 or 0.5	0.5 ⁶⁾				
				2.5-5 A								
5 -5 A												

Table 2. Accessories for Precision Instruments

Type	Use		Standard Rating		Accuracy Class
For LM	Shunt	Attached for terminals	15-30-75 mA	45 mV	0.2
			150-300-750 mA		0.05 or 0.1
			1.5-3-7.5 A		
			15-30 A		
			75 A		
			150 A		
		External	300 A	45 mV	0.1
			750 A		0.2
	1500 A		—		
	Shunt leads		2×1.0 m 2×2.5 m	2×7.5 m \varnothing	—
	Multiplier	Attached for terminals	60-150-300 mV	45 mV	0.2
			0.75-1.5 V		
		External	7.5-15-30-75-150-300-750 V	3 mA	0.1
			1500 V		
For LS	Multiplier	External	260-520-650 V	60 mA	0.1
			1500-3000 V	30 mA	
	Plug type Current Transformer ⁷⁾		0.1-0.2-0.5-1-2-5-10-20-50-100 A	$\frac{5}{5}$ A $\frac{5}{5}$ VA ²⁾	0.1 ²⁾
For LDL	Series Resistor	1 ϕ	120-240-420-600 V	30 mA	0.1
		1 ϕ & balanced 3 ϕ	150-300-450-600 V		
			120-240-420-600 V		
	Neutral Resistor	balanced 3 ϕ	90 V		
	Series Reistor for W. Var	unbalanced 3 ϕ	120 V		

Remarks for Table 1 and 2

- 1) 15...50...150 c/s
- 2) Value at 50 c/s
- 3) 15...50...500 c/s
- 4) 10...50...500 c/s
- 5) 10...50...1500 c/s
- 6) 10...50...150 c/s
- 7) Also used for **LDL**

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