Construct, Conduct & Comprehend Physics Experiments

LEEI-5 Construction of an Ammeter and a Voltmeter

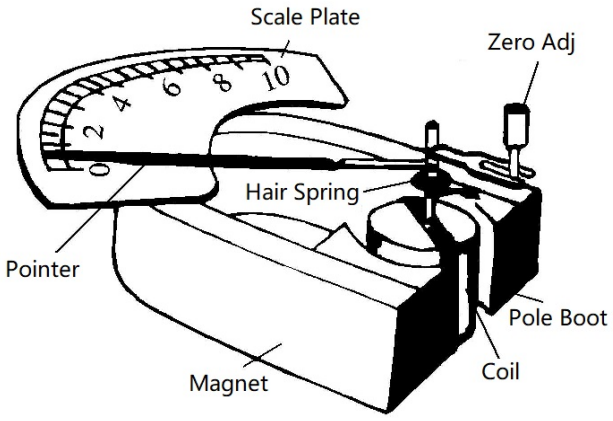
- Rich experiment content
- Clear physical concept
- Stable and reliable experimental result
- Reasonable configuration

Pointer DC ammeters and voltmeters are all constructed from galvanometers. A galvanometer is usually a magneto-electric type ammeter, which only allows to flow micro-amp or milli-amp current, and can only measure very small current and voltage. In actual use, if a large current or voltage is needed to measure, the galvanometer must be modified to expand its measurement range. The modified meter should be calibrated with a standard meter and its accuracy grade should be determined.

This LEEI-5 experimental apparatus provides a complete set of components and devices for the construction of a milliamp meter or a voltmeter, including a DC power supply, a magneto-electric type micro-amp galvanometer, a resistance box, a digital voltmeter, a digital ammeter, and so on. It has features of rich experiment content, clear physical concept, stable and reliable experimental result, and reasonable configuration. It is suitable for teaching labs of undergraduates in colleges.

Specifications

Description	Specifications
DC power supply	1.5 V and 5 V
DC microamp galvanometer	measurement range 0 ~ 100 μA, internal resistance about 1.7 kΩ, accuracy grade 1.5
Digital voltmeter	measurement range: 0 ~ 1.999 V, resolution 0.001 V
Digital ammeter	two measurement ranges: 0 ~ 1.999 mA, resolution 0.001 mA; 0 ~ 199.9 μA, resolution 0.1 μA.
Resistance box	range 0 ~ 99999.9 Ω, resolution 0.1 Ω
Multi-turn potentiometer	0 ~ 33 kΩ continuously adjustable



Configuration schematic of galvanometer

An example of experiment data

The current range of the galvanometer to be modified is $100\mu A$. The internal resistance is measured as $1.72K\Omega$ by the half-deflection method and $1.73K\Omega$ by the substitution method. The substitution method was used in following experiments.

1. Construct a DC ammeter with measurement range 0 ~ 1 mA

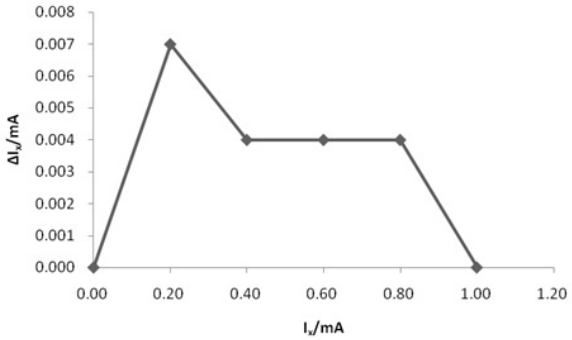
The parallel resistance is calculated as $R_p = \frac{I_g R_g}{I - I_g} = \frac{0.0001 \times 1730}{0.001 - 0.0001} = 192\Omega$.

The experiment result is $R_p = 190\Omega$. The error is about 1%.

Table 1 Calibration data of the modified DC ammeter

Table 1 Data of the constructed ammeter after calibration

Scale of Galvanometer	0	2.0	4.0	6.0	8.0	10.0
Reading of Constructed Ammeter I_{x1}/mA	0	0.20	0.40	0.60	0.80	1.00
Reading of Standard Ammeter I_{01}/mA	0	0.207	0.404	0.604	0.804	1.000
$\Delta I_x = I_0 - I_x / mA$	0	0.007	0.004	0.004	0.004	0



Calibration curve of the constructed DC ammeter

The maximum error of the constructed ammeter is $\frac{0.007}{1} \times 100\% = 0.7\%$. Since $0.5 < 0.7 < 1.0$, the accuracy grade of the constructed meter is 1.0.

Lambda Scientific Systems, Inc.
16300 SW 137th Ave, Unit 132
Miami, FL 33177, USA
Phone: 305.252.3838 Fax: 305.517.3739
E-mail: sales@lambdasys.com
Web: www.lambdasys.com