Chapter 3

Standards of Measurement

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Measurement Standards

Before we can measure something, we must define its dimension and provide some standard, or reference unit, in terms of which the quantity can be expressed numerically. *(Lord Kelvin)*

Types of Standards

Classified by **their function** and **application** to:

- **International**: defined by **international** agreement
- **Primary** (basic): maintained by **national** institutions.
- **Secondary**: maintained by industrial lab.
- **Working**: Principal tools of measurement lab.
- Ex.: calibrating using **standard resistor**

Types of Standards

1. International Standards:

- Are defined by ***international*** agreement
- Have the **highest** possible achieved **accuracy**
- **Periodically** evaluated and checked
- **Not** available to **ordinary** users, maintained at *International Bureau of Weights and Measures*

2. Primary (basic):

- Are maintained by ***national*** institutions.
- Constructed to have **highest possible** accuracy
- Main function is to check the accuracy of ***secondary*** standards

Types of Standards

3. Secondary:

- Used in industrial lab
- for calibrating equipment and components
- Verifying the accuracy of ***working*** standard
- Checked periodically by institutions maintained the primary standards.

4. Working:

- Principal tools of measurement lab.
- Ex.: calibrating using **standard resistor**
- Highly used in ***quality control*** departments

Standards can be Divided to:

1. Physical Standards

- Mass, Length, Volume
- Time and Frequency
- Absolute Ampere
- Resistance Standard
- Voltage Standards
- Capacitance and Inductance standards
- Temperature and Luminous

2. Non-Physical Standards

- *IEEE* : **Standards procedures, Definitions, Levels, Ratings, …. etc**

Standards Examples

- Standards for Mass, Length and Volume
- Time and Frequency Standard
- Electrical Standards
  - Absolute Ampere
  - Resistance Standard
  - Voltage Standards
  - Capacitance Standards
  - Inductance Standards
- Standard for Temperature and Luminous Intensity
- IEEE standards

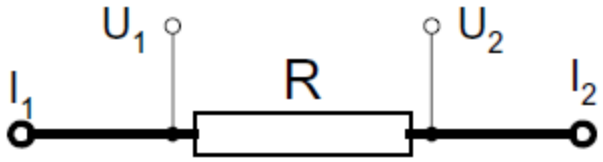
Standards Example

1. The standards of resistance

An example of the standard resistor – model 5615 of Tinsley

(Tinsley Precise Instruments)

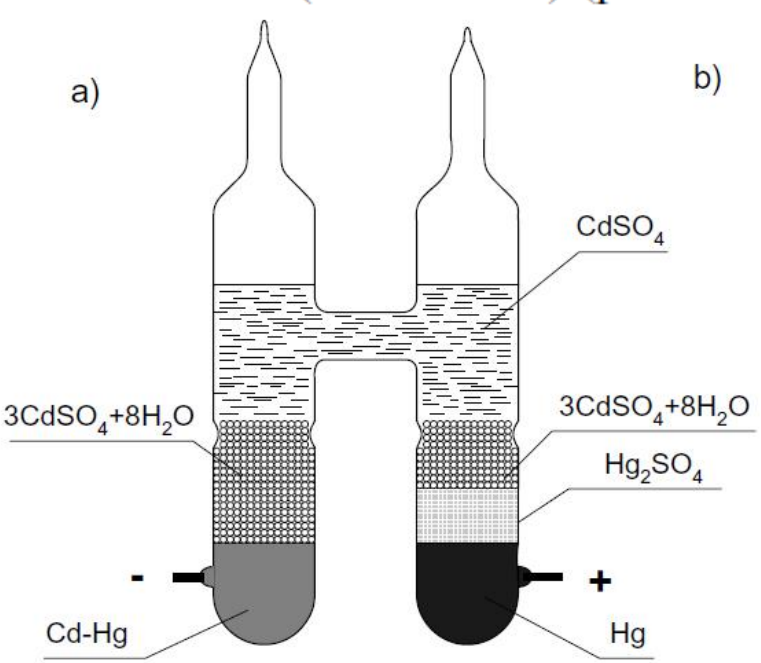
The **resistance** standard is usually equipped with four terminals:
two (larger) terminals are used for the current excitation and
second two (smaller) ones are used as the voltage (potential) terminals



Standards Example

- **2. Material standards of electrical quantities**

Figure 2.35. The standard of voltage – saturated Weston cell (a) and electronic standard of Fluke – model 7000 (Fluke 2005) (permission of Fluke Corporation)



standard of voltage the *Weston cell*

The output *EMF* is from *1.018540 V* to *1.018730 V*

Fluke: This standard enables users to obtain voltage *10 V* or *1.018V*

Standards Example
3. *IEEE* Standards

IEEE

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IEEE STANDARD

4-2013 - IEEE Standard for High-Voltage Testing Techniques

Description: Standard methods and basic techniques for high-voltage testing applicable to all types of apparatus for alternating voltages, direct voltages, lightning impulse voltages, switching impulse voltages, and impulse currents are established in this standard. Sections that deal with alternating voltage, direct voltage, and impulse testing are combined in this revision to organize the technical content for ease of use. In addition, the concept of measurement uncertainty in evaluation of high-voltage and high-current tests is introduced in this version.

STATUS: Active Standard

Working Group: HVTT - HV Test Techniques Working Group

Oversight Committee: PE/PSIM - Power System Instrumentation and Measurements

Sponsor: IEEE Power and Energy Society

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