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Leakage current is the small amount of current that flows through an unwanted path, even when an electrical device is switched off or properly insulated.

In an ideal condition, electricity should stay inside wires and components, but in real life a tiny part of the current always escapes. This escaped current is known as **leakage current**. It is also called **electrical leakage** or **earth leakage current** when the current flows toward the ground.

A simple example: when a fan or motor is running in the house, a nearby connected low-watt LED bulb may glow faintly even when the switch is off. This happens due to leakage current.

What causes Leakage Current?

It happens when current slips through weak or imperfect insulation instead of staying in its proper path.

- Damaged or aged insulation
- Moisture, dust, or dirt on cables or components
- High voltage stress on insulation
- Heat or overloaded wires
- Faulty appliances or loose connections
- Natural leakage in electronic components

When insulation resistance becomes low, leakage current becomes high. This is why **high leakage current** usually indicates a problem in the electrical system.

Leakage Current in Capacitor

Every capacitor allows a small amount of current to leak through its dielectric. New capacitors have low leakage, but as they age, leakage increases. This is known as **capacitor leakage current**.

What is Leakage Voltage?

Due to leakage current, a small unwanted voltage may appear on the metal body of an appliance. This is called **leakage voltage**.

You may feel a mild shock when touching a refrigerator or washing machine because of leakage voltage.

What is Earth Leakage Current?

Earth leakage current is the part of leakage that flows toward the ground. It commonly occurs due to:

- Wet or faulty appliances
- Broken insulation
- Damaged wiring
- Weak earthing

This is why RCCB trips when earth leakage current crosses a safe limit.

What is Acceptable Leakage Current?

Every electrical device has some normal leakage. Most home appliances allow **0.5 mA to 3.5 mA** of safe leakage current. If the leakage increases beyond this, RCCB should trip to protect users.

What is an Earth Leakage Device?

An earth leakage device such as **ELCB** or **RCCB** detects leakage current and disconnects the supply instantly. It protects against electric shock, fire hazards, and insulation failure.

Leakage Current Formula

A simple relation for leakage current is:

$$I_{\text{leakage}} = \frac{V}{R_{\text{insulation}}}$$

If insulation resistance decreases, leakage current increases.

Why Leakage Current Matters?

- Can create electric shock hazard
- Reduces insulation life
- Causes RCCB tripping
- Wastes energy over time
- Can damage sensitive electronics

Leakage current is small but important. It indicates the health of insulation and the safety level of an electrical system. Lower leakage current means safer operation and longer life for appliances. With proper earthing, RCCB, and regular insulation testing, leakage current can be controlled effectively.