

Circuit Protection

RCDs

ENCE3103

Objectives

At the end of the lesson, students are able to :

- ✓ State the common names for RCDs
- ✓ Describe the construction and principle of operation
- ✓ Describe the procedures for testing the operation of RCDs
- ✓ Describe the precautions to be taken when testing circuits containing RCDs.

Residual Current Devices (RCD)

A device for isolating supply to protected circuits, socket outlets, or electrical appliances in the event of a current flow to earth that exceeds a predetermined level

Residual Current Devices (RCD)

- Does not provide overcurrent protection for the circuit. The usual fuse or circuit breaker protection for over currents in the circuit is still required

Common Names for RCD

- Earth-leakage circuit-breaker (ELCB),
- Residual-current circuit-breaker (RCCB),
- Ground-fault interrupter (GFI),
- Core-balance earth-leakage circuit-breaker (CBELCB)

Residual Current Devices (RCD)



Principle of Operation

Normal Condition:

- Current flow in both phase and neutral conductors is the same, but in opposite directions
- Magnetic flux produced by 1 conductor cancels the flux produced by the other conductor

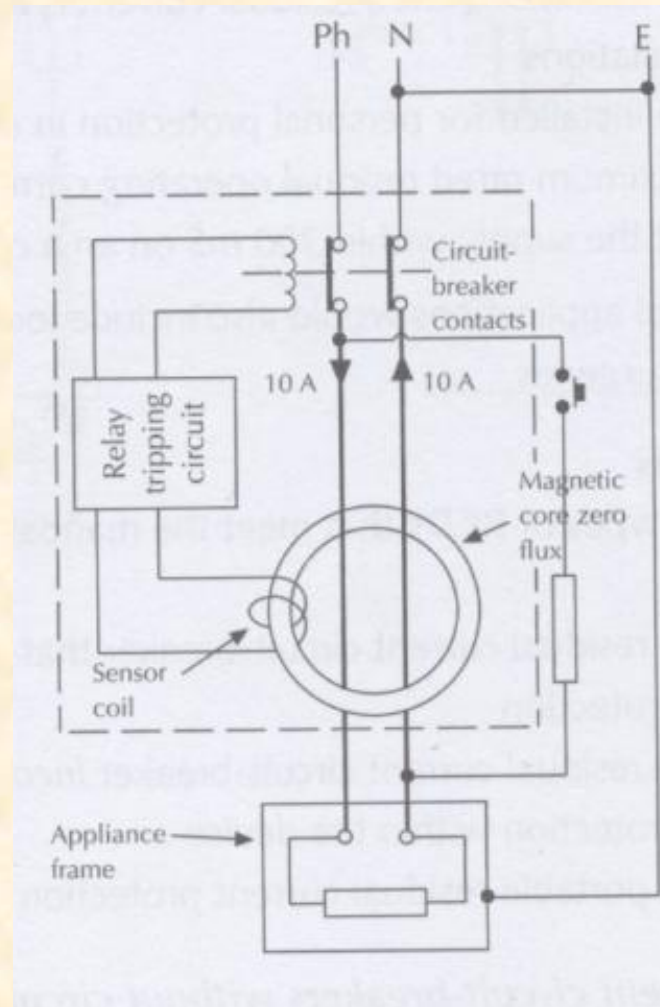
Principle of Operation

Normal Condition :

- Zero flux in the magnetic core

Residual Current Devices (RCD)

- Normal condition



Principle of Operation

Fault condition :

(A fault develops between the appliance element and the case)

➤ Current flow in phase conductor =
current flow in neutral conductor +
earth conductor

Principle of Operation

Fault condition :

i.e. Current flow in phase conductor $>$
current flow in neutral conductor

- A magnetic flux produced in the magnetic core
- Induced an emf causes current to flow from the sensor coil to the relay tripping circuit

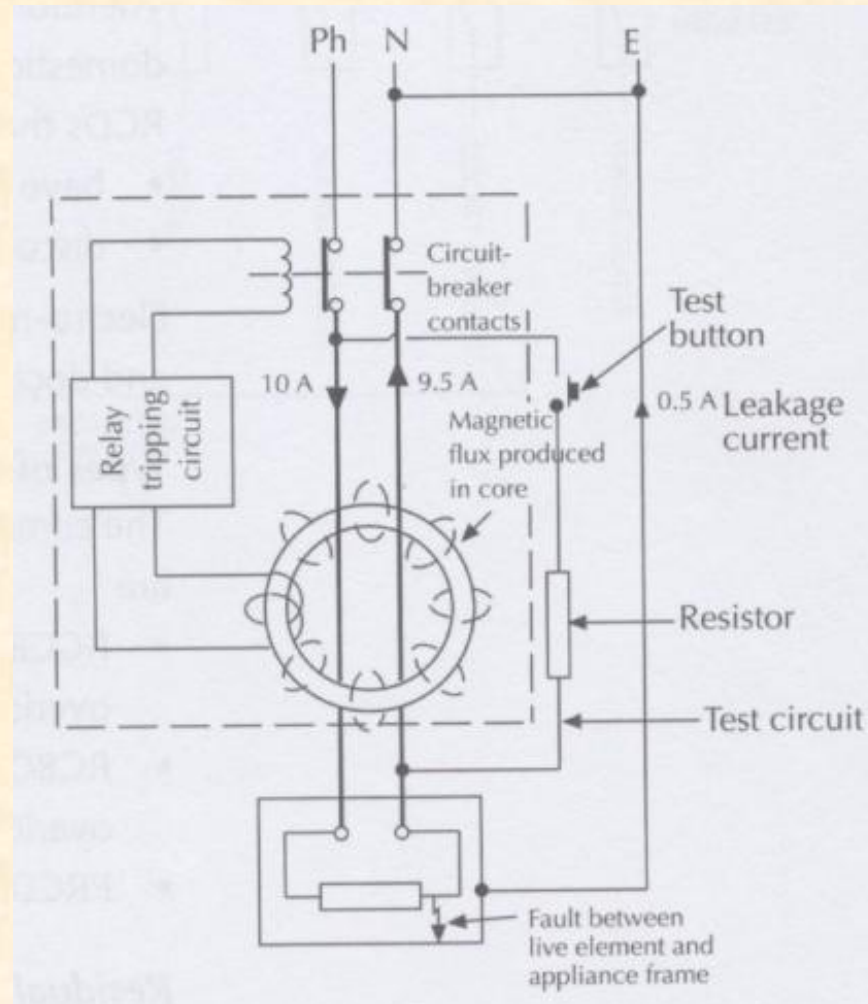
Principle of Operation

Fault condition :

- Which opens the circuit breaker contacts

Residual Current Devices (RCD)

- Fault condition



Residual Current Devices (RCD)

Test circuit

- Depress the test button
- An imbalance in current between the phase and neutral conductors passing through the magnetic core
- Induces a magnetic flux
- Induces an emf causing the relay circuit to open the circuit breaker contacts

Residual Current Devices (RCD)

Test circuit

- The RCD must be reset to reconnect the supply following the test

Residual Current Devices (RCD)

- **Sensitivity**

The value of out-of balance current for which the RCD is set to trip

Residual Current Devices (RCD)

RCDs that are installed in domestic situation for personal protection must :

- Have a maximum rated residual operating current of 30mA
- Disconnect the supply within 300 mS on an ac or pulsating dc fault condition

Residual Current Devices (RCD)

- Recommended should be tested at least once a month to ensure that the tripping action is working
- NZS 3019 (Int) 2002 specifies the electrical tests that should be made for the inspection and testing of low voltage electrical installations that are in service or have been in service. It states

Procedures for Testing Operation of RCDs

The operation of RCDs installed for personal protection from using electrical appliances shall be verified by the use of :

- (a) Test equipment which verifies their operation under the following conditions:
 - (i) At rated residual current for an ac fault, the devices shall operate to disconnect the supply within 300 ms

Procedures for Testing Operation of RCDs

- (ii) At 5 times the rated residual current for an ac fault, the devices shall operate to disconnect the supply within 40 ms;
- (iii) At 1.4 times rated residual current for a pulsating dc fault, the devices shall operate to disconnect the supply within 300 ms; and

Procedures for Testing Operation of RCDs

- (iv) At 7 times rated residual current for a pulsating dc fault, the devices shall operate to disconnect the supply within 40 ms; or
- (b) The integral test device together with confirmation that the RCD is labelled “Type A”

Residual Current Devices (RCD)

Precaution

RCD has an electronic amplifier section which can be easily destroyed by insulation testers (meggers) with a total voltage of 500V or more. **RCD units must be disconnected before insulation tests**

Residual Current Devices (RCD)

Precaution

Warning labels must be attached
near the RCD and the switchboard
supplying it

Wiring Rules

Clause 2.5.2.1

Any device for protection against earth-leakage current shall be capable of interrupting the part of the circuit protected by the device when an earth-leakage current is flowing above a predetermined value.

Devices shall be RCDs complying with AS3190, AS/NZS3175 or AS/NZS61009.1

Wiring Rules

Clause 2.5.2.1

The current rating of an RCD shall not less than the greater of the following :

- (a) The maximum demand of the portion of the electrical installation being protected by the device

Wiring Rules

Clause 2.5.2.1

(b) The highest current rating of any overload protective device on the portion of the electrical installation being protected

Wiring Rules

Clause 2.5.2.1

Notes:

1. To avoid unwanted tripping due to leakage currents and transient disturbances, care should be taken to ensure that the sum of the leakage currents of electrical equipment on the load side of the RCD is less than $\frac{1}{3}$ of its rated residual current

Wiring Rules

Clause 2.5.2.1

Notes:

2. To avoid excessive leakage current causing unwanted tripping where socket outlets are protected by 1 RCD having a rated residual current not greater than 30mA, consideration should be given to the number of socket outlets protected and the nature of electrical equipment likely to be connected to the socket outlets

Wiring Rules

Clause 2.5.2.2

For New Zealand, in addition to complying with clause 2.5.2.1, RCDs shall be of a type where tripping is ensured for residual ac and pulsating dc

Wiring Rules

Clause 2.5.2.2

NOTE: RCDs providing operation under ac and pulsating dc conditions are classified as Type A in AS/NZS 3175 and AS/NZS 61009.1

Wiring Rules

Clause 2.5.3.1

RCDs with a maximum rated residual current of 30mA shall be installed for the protection of the following final subcircuits in domestic electrical installations:

- (a) Socket outlets
- (b) Lighting

Wiring Rules

Clause 2.5.3.1

This requirement need not apply to a socket outlet, or a connecting device installed accordance with clause 4.1 (c). For the connection of fixed or stationary electric cooking appliances, such as ranges, ovens or hotplates

NOTE : See notes to clause 2.5.3.2