



Case Study - Precautions to be taken while checking RCCB / ELCB

Safety (Humans & Equipment's) has been one of the major concerns in all the industries. Safe practices in Industries keep the people working in it safe. And various industries in India and across the world are taking various steps to improvise Human and Equipment safety in their plants. One such step is Installation of ELCBs, RCCBs.

When you install ELCB & RCCB you need to keep checking whether they are functioning properly or not through ELCB tester. Today we are presenting you one such Case Study which happened in one Process industries while testing RCCB through ELCB tester. Nos of ELCB / RCCB Installed are around 500 in that plants.

Background

Maintenance Engineers were testing the RCCB at the various locations in the plants as a part of routine testing activity. After carrying out the testing of total 405 numbers of Single Phase and Three Phase RCCBs, maintenance team reach for Testing RCCB where an incident was awaiting to happen.

At this location as per the procedure, Engineer has done the Following steps:

- Connected the ELCB Testing Kit between R – Phase and Earthing and as per the testing guidelines of the test kit, tripping current was gradually increased to 30 mA.
- As per the rating, at this ampere RCCB should have been tripped, but did not Trip. Hence next higher Trip Applied Current setting at 50 mA was selected in Test Kit and test was carried out. At this setting also RCCB did not trip.
- As the RCCB did not trip, the above-mentioned tests were done for Y-Phase but again RCCB did not trip.
- After failure of the above tests, it was considered to operate the RCCB from Test Trip Push button provided at the Front. Engineer had pressed the Test trip button and Short circuit arc flash had happened causing the fire in LDB.
- The supply of the short circuit was isolated from the Source side and the fire was extinguished with proper fire hydrant.
- And to the grace of GOD, there was neither any burning nor any kind of Injury to Engineer.

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Condition of LDB after Short circuit in RCCB

- **Fault Incident**

- Location of fault : LDB
- Rating of RCCB : 63 A, $I\Delta n=30$ mA
- Testing of RCCB done with Similar Procedure before Incident Happened: 405 Nos.
- Test Kit used : Digital RCB (ELCB) Tester

Yes, that happened after engineer tried to trip the ELCB with Trip test button provided on RCCB.

To understand how that happens, you must understand the internal diagrams and functioning of RCCB.

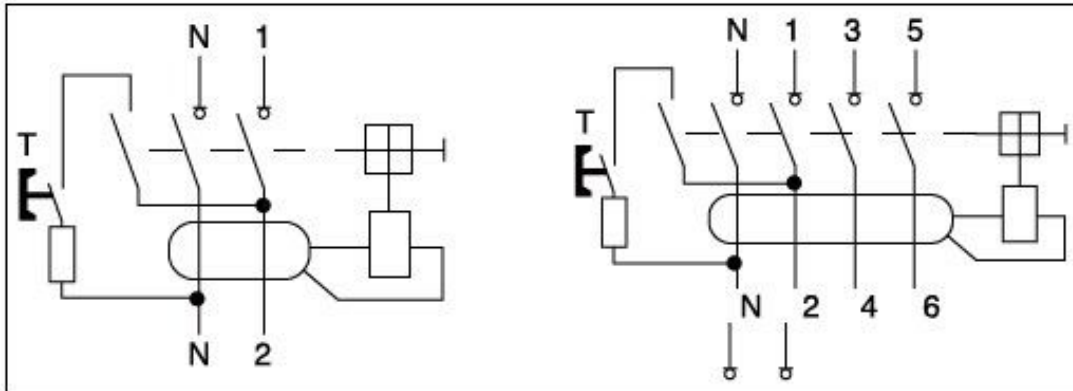
Internal Connection Diagram of the RCCB :

All the three phases and the neutral wires are wound on the magnetic core or CBCT and a solenoid / Tripping coil is wound and energised from the coil wound on the magnetic core or CBCT.

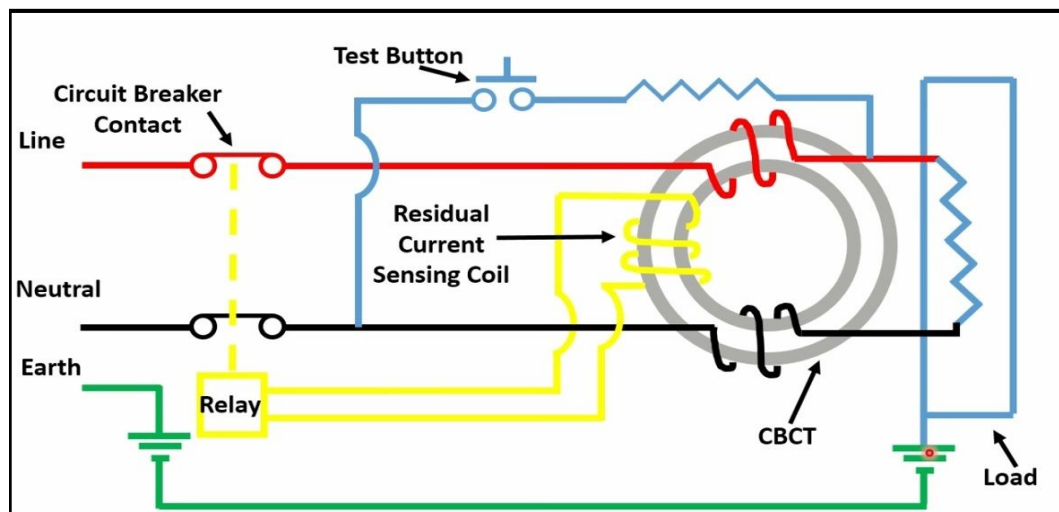
Any unbalance will cause the magnetic core to produce the voltages across the tripping coil or CBCT to produce current across its secondary and will get the trip command once the current is higher than the operating current.



A healthy RCCB operates when a leakage current crosses the set limit. As per the standard practice, while testing the said RCCB, the leakage current was injected between Incoming N and Outgoing 2 as given in the Figure-1.



Schematic Diagram of RCCB (1)



Schematic Diagram of RCCB (2)

A healthy RCCB usually gives a Trip command on injection of a specified value of Leakage Current, but in this case, it did not trip in any of the phases. Then, as per standard practice, Engineer pushed the Test Trip PB which should have manually tripped the RCCB, but it did not and a flash-over resulted all of a sudden.

Supply from the source to the said LDB/RCCB was cut-off and the flashed-over LDB/RCCB was isolated.

As per the drawing suggested, Trip Test push button is connected between any phase and the neutral wire through a high value of Resistance.



Once the Test trip button is pressed, Phase and Neutral are connected through resistance and tripping current is flow through coil and Tripping is issued and Mechanical Operation of the Switch is done to open the switch.

← **Internal Construction of RCCB**

Possible causes of the Fault Incidents:

- If we again look at the diagram, it may be noted that when injecting the Leakage Current between any of the given points (N-2, N-4, N-6), it passes through the Trip Coil of the RCCB and a healthy RCCB operates/trips. This defines the healthiness of the Trip Coil.
- In this case, injection of Leakage Current didn't trip the RCCB, hence it is established that Trip Coil was faulty.
- In this case, pushing of the Test Trip PB resulted in Flash-over, it means the Series Resistor was internally shorted, which is a rarest-of-the-rare case, but can happen.
- If any Case the trip Resistance is shorted or By-passed, Test Trip Push button will short Phase-Neutral together. Which RCCB Cannot isolate, which make SC current to flow time more than its rating and that started the fire.

Conclusion that can be drawn from this incident:

- As per instructions mentioned in various the RCCB manuals, it is a general practice to Test RCCB in every 3 or 6 Months with Test Push Button operation to check the healthiness of the RCCB.
- Apart from this test, the procedures mentioned above also insures the healthiness of the RCCB through ELCB tester.
- Only Reason for burning of the RCCB while pressing the Test Push button could be internal failure that created SC at RCCB Location, Which RCCB could not handle.



Precautions to be taken:

Now, the common practice of Maintenance engineer to Check RCCB /ELCB is through ELCB tester or through manual trip to ensure the healthiness.

Front View of RCCB having Test trip



It is usually a safe practice to test the RCCB the way engineer tested it, internationally. Usually, RCCB testing with the Test Push button is also a safe way to check the RCCB.

In this case, RCCB was tested through Tester, but didn't trip 2 times, so the **1st** Precaution is if RCCB/ELCB doesn't trip through tester, so Just replace it.

2nd Precaution is Extra care should be taken by wearing the appropriate PPEs like Arc Flash Gloves when RCCB is to be tested in open condition. Wear properly rated Hand-gloves and Safety Goggles to minimise the damage/injury in case of any such fault/accident even when RCCB is enclosed securely. However, we will suggest using RCCB/ELCB Tester for testing it.

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