

TECHNICAL NEWS

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Quarterly Technical Newsletter of Australia's leading supplier of low-voltage motor control and switchgear.

RCDs are Saving Lives

In 1991 the Wiring Rules AS3000 introduced earth leakage protection (or RCDs as they are now known) to new domestic dwellings. There are now a sufficient number of homes fitted with RCDs to show a major improvement in the accident rate. The results of the move can now start to be measured and lives have been saved and the devices have also proven to offer acceptable reliability. It is time now to consider old dwellings and the commercial and industrial installations.

History

The first attempt to provide increased protection against electrical shock was provided by voltage sensitive devices. These quickly became discredited by their reduced reliability and some rather unsavoury door to door sales methods.

Prior to implementing mandatory use of the residual current protection devices, Standards Australia via the committee responsible for AS3190, which is the RCD standard, had to ensure devices on the market at the time could offer reliable operation under varying operating conditions.

In particular an aging test was applied to try and predict how the devices would perform over a period of time. This test

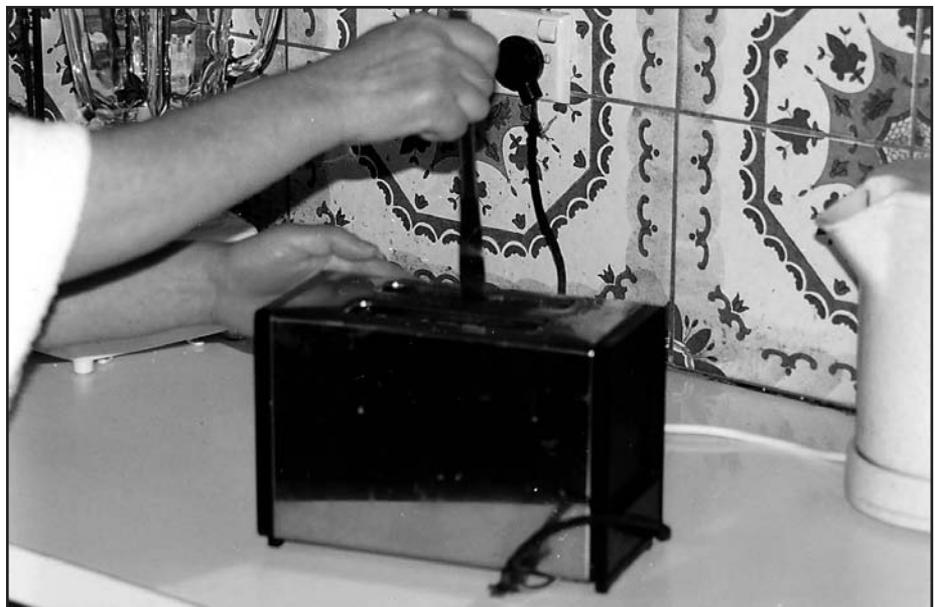
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Direct contact with active and earth can produce lethal results.

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involved operating the devices at cycling temperatures to try and detect weakness in the design.

The results of these tests were encouraging as most of the products tested passed the tests. The applicable standard AS3190 was updated to include the tests for reliability as well as tests to try and detect susceptibility to nuisance tripping. If the devices tripped in response to events other than current leakage to earth, this would also discredit their use.

At Present

The wiring Rules as defined in AS3000 - 1991 require that, new domestic electrical installations are fitted with earth leakage protection on circuits supplying GPOs. GPOs used to supply refrigerators or food freezers are excluded. Lighting circuits and those supplying fixed items such as stoves or hot water services do not need to be protected.

The limited scope of the AS3000 requirements needs to be reviewed in the light of the performance of these devices, the accident rates and community attitudes.

The devices themselves have proven to be reliable and this seems to vindicate the changes made to AS3190. The range of devices has also expanded greatly and while it was common to fit a single RCD to protect a whole installation it is now more practical to fit more selective

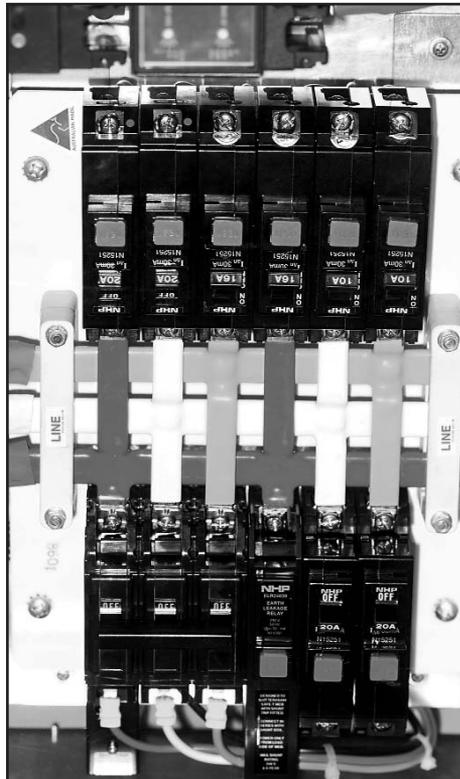
devices. This can be down to individual protection of each GPO. Devices that offer both overcurrent and earth leakage protection provide both a practical and simple solution for most applications.

The accident statistics show, that, the areas excluded from mandatory fitting of RCDs are not free from incidents. While the initial mandatory introduction in AS3000 has proved to save lives all other areas need to be looked at. In domestic installations lighting circuits, refrigeration points and fixed appliances should all be included. In the case of refrigeration it would be found that many new houses actually have protection on the circuits supplying the refrigeration. The original concern that the devices could be blamed for spoiling large

amounts of food would seem no longer valid.

The number of fatal accidents in commercial and industrial installations are in the same order as domestic installations. There seems to be no valid reason why these areas should be excluded from, at least, some mandatory application of RCD's. To some extent the Workcover Authority is forcing greater use of earth leakage protection devices. The Authority recommends that power outlets supplying portable electrical equipment be protected, as well as making other recommendations in regard to the use of RCDs.

Because of the legal implications or, worker injury, retrofitting of old installations in the commercial and industrial area have already started. The availability of devices that can be easily fitted to existing switchboards has greatly assisted this process.



Safe-T single pole width earth leakage circuit breakers can be easily retro-fitted in industrial and commercial applications.

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Will it Really Shock You

As with any other accident, contact with live electrical conductors produces a range of results from no injury at all to death. ¹⁾ "In Queensland 20 electrical fatalities were recorded for the year ending 30 June 1997. For recorded electrical accidents over a six year period there were 4,880 incidents. The number of people who receive a shock but never report it must run into many thousands per year in Australia."

The two major factors that determine the severity of an electric shock are the actual current and the duration of the shock. The RCD can only influence the duration of the shock and not the current that flows. If the current flow is limited only by the impedance of the body the maximum current that can flow with a potential of 240 V is 240 mA. This is based on the body having a minimum impedance of 1000 ohm when measured from hand to hand or, hand to foot. A common misbelief is that the leakage current rating of the RCD defines the shock current.

Two connections must be made before current will flow. Contact with the active conductor will usually be fairly direct. This is by touching the conductor itself or via touching some other metal conductor that has come into contact with the active conductor. The connection to earth is not usually so direct and in some situations virtually impossible. There

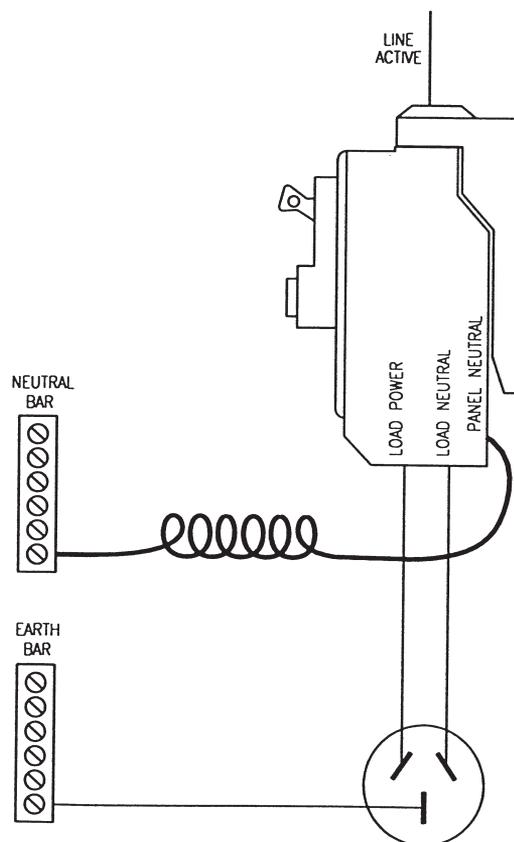
will be no exposure at all to earth with the building itself being insulated and the electrical equipment double-insulated with no connection to the GPO earth. The situation is completely different outdoors as good electrical contact with earth is relatively easy. The fact that for a shock, a person needs to be both in contact with the active as well as 'earthed' at the same time provides a natural limit to the number of occasions that a shock is received.

How Quick

The aim of any RCD used for electrical safety is to prevent ventricular fibrillation, which is a disturbance in the normal heart rhythm and can lead to death. Research has shown that at a current of 240 mA

and a duration of 50 mSec will have no harmful effect. At 30 mA the time can be greater and a time of one second should not cause a problem. The Australian Standards require RCD's to operate within these times and can therefore prevent harm caused by an electric shock.

Some users have set their own requirements for operating time. These requirements generally require a shorter time than the allowed 300 mSec at 30 mA. While this may be in the belief that better protection is being offered it is ignoring the fact the delay has been deliberately put there. There are transient effects that can cause the RCD to sense a leakage current. Capacitance to earth is one cause and this can create a large earth surge



*Typical RCD
connection for single
phase circuit.*

Note: ¹⁾ Information quoted from EDAQ October 1997, R. Dunstan, "The application of residual current devices in the minimisation of the frequency and severity of electrical accidents in Queensland".

on first turn on but is not something that should cause a trip. The built in delay stabilises the RCD and does not compromise safety.

Fire

The performance of RCDs is usually always related to their ability to limit harm caused by electric shock. There seems little data related to the ability of the devices to sense breakdown of insulation and thus prevent fires.

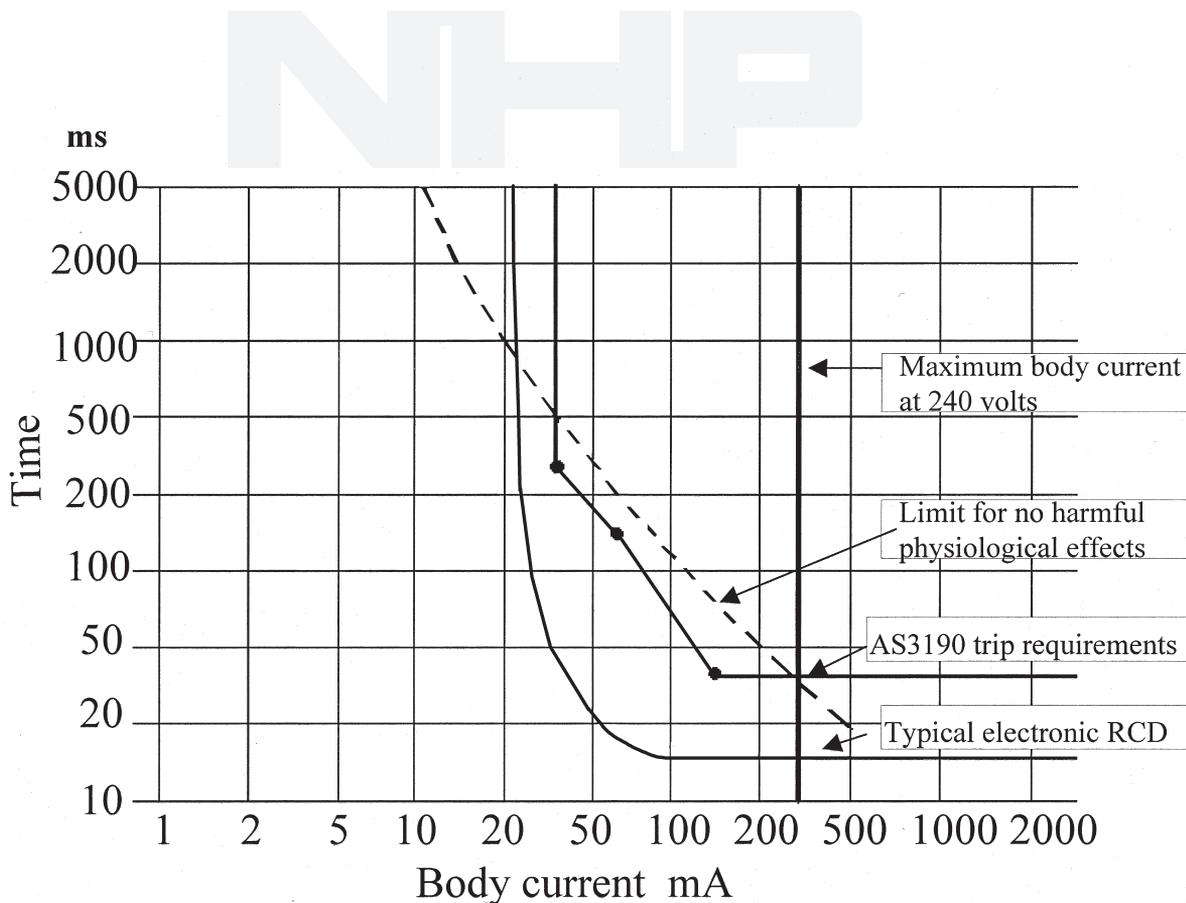
At a sensitivity of 30 mA the power threshold is 7.2 watts. If the leakage is to earth this threshold would prevent a fire

starting. Unfortunately electrical faults are not always to earth. Poor connections or in line faults would be more common and these would not be detected unless they caused a current flow to earth. This may happen but only when the fault is at an advanced stage of breakdown.

Fire is a major source of property damage and preventable death. If RCDs prevent a fire from starting in the first place they can contribute to an improvement in safety. To evaluate their performance requires expert examination of fires attributed

to 'electrical fault' to evaluate whether an RCD could have prevented a fire starting. The damage caused by fire makes this a very difficult task and accurate statistics seem unlikely. For this reason the benefits of RCDs for fire prevention is likely to remain more theoretical than statistically proven.

It must be noted however the use of RCDs at sensitivities of 100 or 300 mA are used extensively in other countries, for property protection as well as to reduce the risk of shock caused by poor earthing of exposed metal.



RCDs can limit the duration of an electric shock to safe levels.

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The Future

The legal responsibility placed on employers to provide a safe working environment will continue to cause a strong demand for RCDs in commercial and industrial applications. There is a case for the Wiring Rules to implement at least some mandatory installation in new buildings to clarify what should be done.

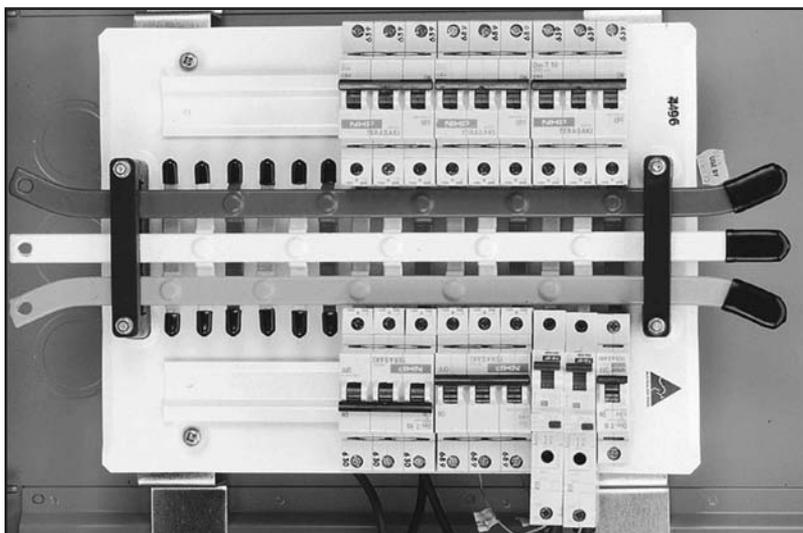
For domestic installations the products are available and their worth and reliability is proven. The next step should be taken to include RCDs on all circuits in new dwellings. This leaves the issue of existing dwellings without RCDs. These will probably last for about another 50 years before they are demolished or renovated. A lot of dwellings have been upgraded by safety concerned owners but there is still a long way to go. Education and incentives should be provided to encourage upgrading to RCDs rather than waiting for the building to fall over.



Single pole Din style RCD.

Application

The Din-Safe single pole (pictured above) width residual current circuit breaker will fit the standard ND chassis (pictured below) for use in a NDB/NPP panelboard. The revolutionary design makes it possible to provide an MCB complete with earth leakage protection in an 18mm wide module which allows a greater number of devices to be fitted into a distribution board.



Single pole RCDs sit easily on chassis mount systems.

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