

Protection of Electrical Installations

Matija Strehar, grad. eng., ETI d.d.

When speaking about the protection of electrical installation, the most often meant is the overcurrent protection. This is the protection that must be activated in case of exceedingly high currents in an installation (the currents whose value is higher than expected). It can be achieved using safety fuses, or (automatic) circuit breakers; there are two other names: LS and MCB switches. The task of that protection is to switch out faulty circuits, and thereby protect the loads that are connected to those circuits, thus preventing the consequences (in the first place thermal overloading of conductors, and fire risk). In new buildings are in dwelling electrical installations almost exclusively used circuit breakers owing to their numerous advantages:

- simple use,
- multiple use (no replacement is needed after operation),
- smaller size,
- increased safety.

There is a large choice of circuit breakers by various manufacturers on the market. Their basic technical characteristics are:

- rated current,
- breaking characteristic,
- short-circuit capacity, etc.

The rated current value of the protection device must provide the best possible overcurrent protection of an installation.

When choosing the breaking characteristics, usually are available B, C and (sometimes) also D – complying with the IEC 60898 standard. For a residential installation the most often used is B characteristic. However, if loads with high starting current are to be connected to that installation, (e.g. angle grinders), C characteristics should be used, because it is more resistant to undesired switching-offs at the start.

The short-circuit capacity is declared by its maximum current. A circuit breaker (according to requirements of the standard) must be strong enough to break a circuit three times, and still preserve specific technical characteristics required.



Circuit breaker in switched-in and switched-out condition



Residual current circuit breaker with overcurrent protection built-in (RCBO)

The values, marked on the products, are: 3.000, 4.000, 6.000 and 10.000 A. It is true that usually in housing installation the actual short-circuit currents are lower. But for sure a circuit breaker which is able to break three times 6.000 A, can still more times break lower short-circuit current than a circuit breaker which is declared to be able to break three times 3.000 A. That's the reason why in some countries (e.g. Germany) the installation of circuit breakers with the short-circuit capacity under 6.000 A is not allowed; so one must be careful when choosing a circuit breaker, it isn't recommendable to choose circuit breakers having the lowest short-circuit capacity, which is, of course, the cheapest. In addition, neither should be ignored the quality sign on products (e.g. VDE, KEMA and the like), because it ensures the product has been submitted to an appropriate type test.

For single-phase circuits single-phase (single-pole) circuit breakers are used, and for three-phase circuits – three-pole circuit breakers that are specially produced and calibrated by the manufacturer. Therefore composition of three-pole circuit breakers using three single-pole devices is not an adequate solution, and "in the field composed" circuit breaker doesn't ensure all technical characteristics prescribed.

The second type of protection for an electric installation is protection against electric shock, i.e. against harmful effects of electric current on human body. Three levels of such a protection are known:

- protection against direct contact,
- protection against indirect contact,
- additional protection by using high-sensitive protection switches.

Since the safety is more and more important, for better protection of humans and animals and better fire safety is steadily being developed and perfected a third level – additional protection. The matter concerns the use of so-called residual current circuit breakers (old names for these protection devices are: current protection switches, FI & FID switches, and abbreviations RCCB, RCD). Additional protection for people and animals is enabled only by high-sensitivity protective switches of 30 mA or less. The protective switches with sensitivity of 100 mA are suitable only for fire protection, whereas protective switches with sensitivity of 300 or 500 mA are only convenient to be used as main protective switches.



Residual current circuit breaker (two-pole – single-phase and three-pole – three-phase circuit breaker)

The residual current circuit breakers are recommended wherever the risk of electric shock is increased: in bathrooms and other humid and wet rooms, nurseries and workshops, where portable electric tools are often used. Needless to say that their use is much expanded in hospitals, kindergartens and schools. The residual current circuit breakers can be used in all installation systems where null and protective conductors are separated. In old electrical installations where so-called nulling is still used such protective switches cannot be used.

Both types of protection: against overcurrent and against electric shock can be combined into one single protective device, named residual current circuit breaker with overcurrent protection (other

names for this device: combined protective switch, FI/LS switch, RCBO). These devices include technical characteristics that are a combination of characteristics of both previous protective devices (rated current, breaking characteristic, short-circuit capacity, current sensitivity, etc.). By means of such a device a full-scale protection of electrical installations in a room can be achieved.