

Electrical hazards and Human safety

Typically when human being comes in contact with electrically live part, electric current passes through the person. The effect can be a very light sensation to serious electrical hazard. Typically allowable threshold values are indicated below. However the values may vary depending on different cases.

- 25mA in alternating current at 50Hz
- 50mA in direct current

The values beyond the threshold indicated can have serious electric hazard and can be life threatening.

The electric resistance of human being is small enough to allow electric current to pass through the body. Water with dissolved salts composes major portion of human body makes human body a good conductor. There are many experiments conducted in various scenarios and it is found that the resistance of human body is between 1000Ω and 5000 Ω which depends on many factors. The following 2 scenario can be considered as typical case of comparison.

- Case 1 - A person without shoes, wet skin and in a wet area might have resistance of 1000Ω
- Case 2 - A person with shoes, dry skin and totally dry area might have resistance of 5000Ω

With the above analysis and applying ohm's law, one can calculate maximum voltage that guarantees safety when a person comes in contact with live part. The values are comparable to values prescribed in standard CEI 64-8.

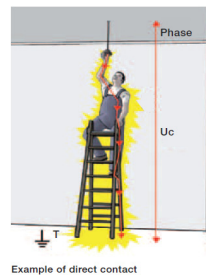
Calculation dangerous threshold voltage @ 2000Ω			
	Resistance	Threshold current	Threshold voltage
AC System	2000	25mA	50V
DC System	2000	50mA	100V

There 2 types of electrocution a person can be subjected to.

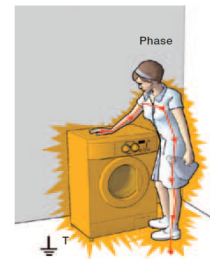
- Direct contact
- Indirect contact

Types of Electrocution

Direct contact	Indirect contact
Contact with an active part of the system, normally under voltage, such as, for example a conductor or a terminal clamp.	Contact with the conducting parts that are found accidentally and unforeseeably under voltage, as a result of an isolation problem, for example the enclosure of a washing machine.



Example of direct contact



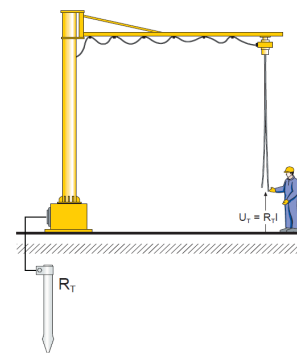
Example of indirect contact

The above parameters prove that operating devices at lower voltages provides utmost safety particularly for those areas where there is human interface.

The Standard IEC 60364 clearly defines that for indirect contact case, automatic disconnection has to be ensured by implementing right protection.

For example take a case indicated in the picture here. A person is operating the crane with a pendant. In the event he comes across indirect contact, the protection system should ensure power disconnected before threshold value U_T reaches 50V. This threshold voltage as defined earlier depends on application.

If the scenario were to be in a hospital and within group 2 medical location, threshold voltage level gets limited to 25V. Please refer to earlier journals on selection criteria for earth leakage protection (March 2012 and September 2012).



With both above cases, it is very much necessary to implement right protection based on area of application. One more important aspect which has to be taken into consideration before implementing protection is type of earthing system (TN,TT,IT).

With all these facts taken into consideration, Standard CEI 64-8 has classified supply voltage into three categories.

- Functional Extra Low Voltage (FELV)
- Protective Extra Low Voltage (PELV)
- Safety Extra Low Voltage (SELV)

The below table provides insight into different supply voltage options.

Typology: very low voltage...			
	FELV-functional (Functional Extra Low Voltage)	PELV-protective (Protective Extra Low Voltage)	SELV-safety (Safety Extra Low Voltage)
Layout for alternating currents			
Description	Special insulation is not required. The loads are not isolated by grounding.	Presence of a special isolation. The loads are not isolated by grounding.	Presence of a special isolation. The loads are not isolated by grounding.
"Safety" note	■	■■	■■■■

ABB Offers comprehensive solution in terms Safety power supplies, Earth leakage protection devices and Insulation monitoring devices (IMD).

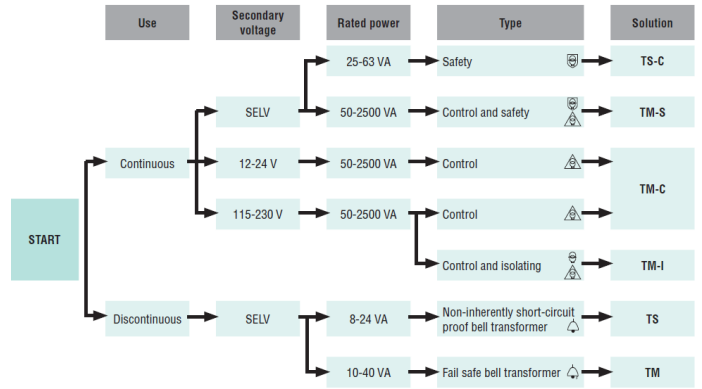
IMD's



Earth leakage protection (With MCCB/MCB/Dedicated relays and RCCB)



Safety Power supply units



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