

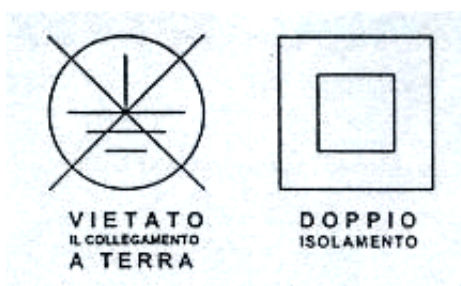
Safety of electrical installations without automatic breaking of the circuit

Date: Venerdì, febbraio 15 @ 12:11:51 CET

Topic: Educational Lighting Site

The Law Regulation CEI64-8/4 establishes the methodologies for this typology of protection

Fig.1-Symbols for the prohibition of earthing systems and double insulation



NO EARTHING SYSTEM | DOUBLE INSULATION

"Direct contact" and "Indirect contact" with reference to the need of avoiding any accident caused by the contact between people and live metal parts; of the two types of contacts, the "indirect" one is certainly the most insidious one because it involves metal parts that are normally not live and thus easily accessible. The origin of the electrical accident by indirect contact is normally to attribute to the insulation of the electrical parts with subsequent contact between live conductors and the metal casing of the equipment; in order to prevent such an event, a strategy aimed at guaranteeing the integrity of the electrical insulation can be used in all the foreseeable operative conditions of the equipment itself, thus making unnecessary (if not even contraindicated) the connection to a safety earthing system eventually equipped with an automatic breaking device. This structural philosophy is very common in electric appliances, which (until the coming into force of the law 46/90) were normally used in houses that had an electric installation without a safety grounding or that were equipped with an earthing system not subject to inspections. In industrial applications the DPR547/55 prescribes that an efficient earthing system must be present in all work places; this does not mean that, in case of verified functional needs, the protection against indirect contacts cannot be obtained with methods that differ from the classic earthing system/automatic breaking combination. The Law Regulation CEI64-8/4 establishes that, as a matter of fact, "protection without connection to a earthing system and thus without automatic breaking of the circuit" must be obtained with:

a) The use of reinforced insulation components (class II);

b) Electric separation of the protected system.

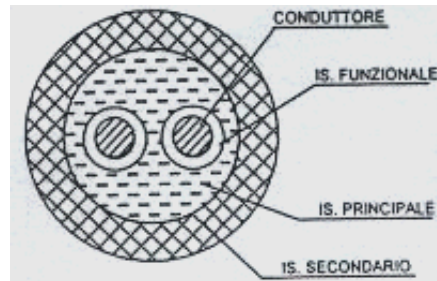
Class II equipment

As already mentioned, whenever we are not sure of the presence of an efficient earthing system, it is necessary to protect the equipment with a double insulation of live parts; in this way, even in the case of the giving in of the main insulation, the supplementary insulation remains reliable. To better understand the basic concept of double insulation, it is necessary to clarify the definitions given by the law regulations:

-Functional insulation: it's the insulation that, by separating conductors and different voltages, makes possible the functioning of the equipment.

-Supplementary insulation: it's an independent insulation added to the main one in order to create the double insulation.

Fig.2-Sezione di cavo bipolare in doppio isolamento

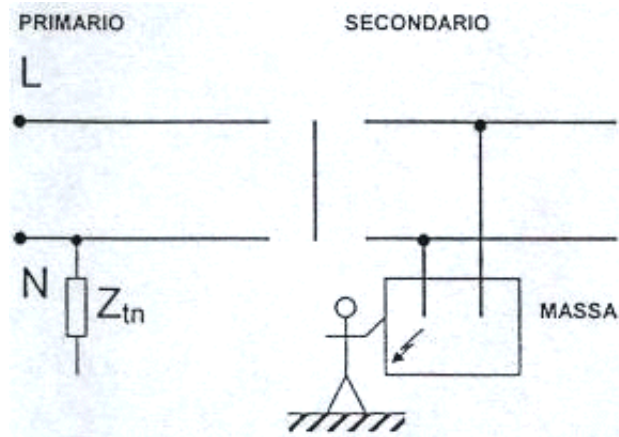


As a rule, functional insulation must not be considered a protective insulation, for instance think of the enamelling of the wire used to make the winding of a transformer. Eventual accessible metal parts (which form part of the external wrapping) must not be connected to the earthing system (if existing) in order to avoid the danger of the extraneous earth, that is the introduction of dangerous electrical potentials caused by failures in other equipments connected to the system. With regard to the latter, it is important to remember that an "improper" earthing system, with the consequent creation of extraneous earth, can be generated by the screenings of the signal cable. In such cases it is appropriate to inspect the independence of the various branches of the earthing system so that we can be assured about the co-ordination of the protections, which remain, at this point, the only reliable safety measure. In the world of audio equipments and, in general, of equipments for entertainment, there are, unfortunately, many typologies of earthing system; some equipments of Hi-Fi origin (for domestic use) are class II, other professional equipments include the earthing system but regrettably also allow interactions that are not entirely standardized between protective earth and signal earth. The consequences of this incompatibility are known to all and sometimes, unfortunately, such needs are sacrificed in the name of functionality.

Protection by electric separation The inspiring principle of protection by electric separation is the permanent breaking of the reclosing way of an eventual fault current by means of an insulated transformer, that is a transformer that can ensure the complete separation (even in the case of a fault) between the primary and the secondary winding; such transformer can have a 1:1 transformation ratio, or lower the voltage value to the secondary down to about 50V, in this case it is defined "safety transformer". In the case of a single fault of the earthing system in the secondary circuit no fault currents are generated because the relative circuit is broken by the transformer; in reality, a weak current circulates all the same because of the parasite capacity between the cables and the earth, and this is the reason why the law regulation recommends to limit the development of the secondary circuit so that the product of the nominal voltage by the length does not exceed the value of 100,000 and, in any case, that the maximum length of the ducts does not exceed 500 meters. It is absolutely important that the transformer is able to ensure this electric separation because this represents the safety of the secondary circuit; for this reason, insulation and safety transformers must be in conformity with the specific law regulation CEI14-6 (EN60742).

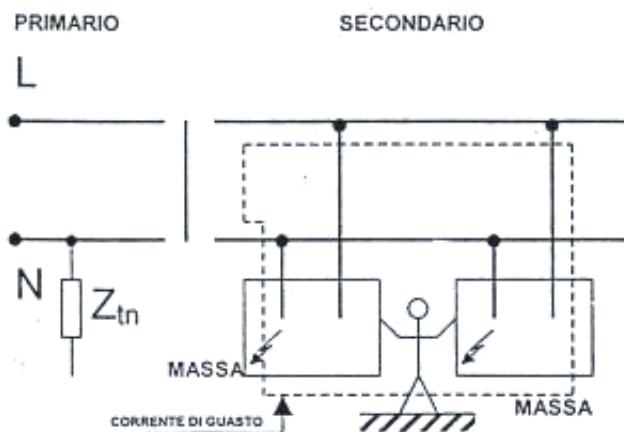
An abstract is shown in the relative box.

Fig.3-Single earth fault in the secondary circuit



With regard to the plant supplied by the insulated transformer, the law regulation prohibits the earthing system of such plant; in particular, it prohibits to connect such earths to the protective earth of the primary circuit because, in this way, all the advantages of the electric separation would be nullified and extraneous earths would then be introduced. However, it is necessary to include a protective system in case of a double earth fault on equipments that are simultaneously accessible.

Fig.4-Double non protected earth fault



In this case, the fault current which is present in the secondary circuit is limited only by the resistance of the person and by the whole impedance of the winding/line system; if a maximum current automatic device with a very rapid intervention time is not present, the situation becomes extremely dangerous for the injured person. To avoid the danger foreseen in this possible situation it is necessary to effect an equipotential connection between all the equipments installed on the secondary circuit; in this way, the double earth fault is seen as a short circuit and provokes the intervention of maximum current automatic protections even before the indirect contact takes place with a person.

Fig.5-Double earth fault with equipotential protection

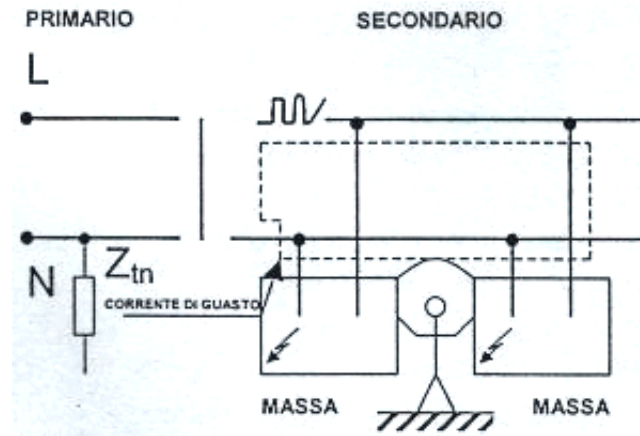


Fig.6-Essential symbols for transformers



This article comes from Accademia della Luce - educazione alle tecniche della luce
<http://www.accademiadellaluce.it>

The URL for this story is:
<http://www.accademiadellaluce.it/article.php?sid=65>