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MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

12. Operating safety of electrical devices

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12.1. Definitions, basics, qualified persons

12.1.1. Basic definitions

- The operation of the electrical devices – the operations that are related with the operation of electrical devices e.g. switching on - off, regulation, reading values of permanently mounted apparatus, the change of screwed and internal apparatus fuses, bulbs, the inspection of apparatus etc.
- The work on the electrical devices - mounting, revision, service the electrical devices. All activities about securing the stand and measuring with portable measurement belong here, too.
- Active part of electrical device is conductor or conducting part determined for being energized during usual operation.
- Exposed conductive part of electrical device is conducting part that is touchable and is not usually active, but it may become active part in the case of failure.
- Basic insulation- insulation of active parts for basic protection
- Additional insulation - insulation used for inactive parts
- Grounding - protective conductive connection to the earth

12.1.2. Qualified persons

The safety rules for operating and servicing the electrical devices of all kinds and voltage categories and acting in their neighborhood is defined by a standard. All the orders and instruction for servicing and operating the electrical devices and the activity or the stay in their neighborhood must be accomplished in correspondence with this standard (Kocman S. et all: The work safety in FEI laboratories). According to the notice No. 50/1978, Col. the persons are divided into groups according to their electrotechnical capability, e.g.:

- **electrically instructed persons:**
  - after participating the lesson, signing a form or passing the exam can do:
  - operate simple electrical apparatus
  - work with electrical apparatus of low voltage de-energized according to instructions
  - work with supervision in the neighborhood of uncovered parts of energized electrical apparatus of low voltage in the distance higher than 20 cm
- **electrically skilled persons – electrically qualified persons:**
  - education in the field of electrical engineering and required length of qualified practice

More information about safety rules of students are in: Kocman S. et all: The work safety in FEI laboratories.

12.2. Basic requests for safe work with electrical devices

It is necessary (in some cases) to secure a condition of electrical device in cases of performing of activities (work on electrical devices) in such way that work will be safe. That means the relevant device must be demonstrably without voltage and the voltage cannot get on it unintentionally (Meduna, V., Kocman, S.: Safety in electrical engineering). As regards persons these rules and operations must be taken into account and done:

- person´s responsibility
- to evaluate risks
- to secure all safeguards
- to determine all safe working processes
  - to switch-off the breaker to de-energize equipment
  - to ensure against re-switching
  - testing of state (measurement of voltage)
  - ground and short-circuit the device (not at low voltage)
  - marking and enclosing of workplace or device
  - use personal protective equipment
  - use the right tools for the job

For a safe and reliable function of devices is necessary to ensure:

- protection against electric shock
- protection of active and inactive parts
- protection against overcurrent, overvoltage
- using uninterruptible power supply (UPS)
- emergency stop
- to place warning signs on the device



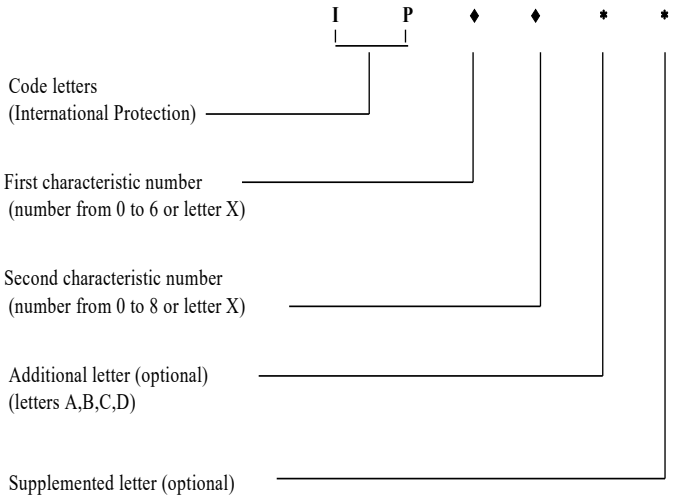




12.3. IP code, external influences

12.3.1. IP code

IP code – coding system which marks degrees of cover protection against dangerous parts touch, against getting solid foreign figures or water into and which also provides next information relatively to this protection (Meduna, V., Kocman, S.: Safety in electrical engineering).



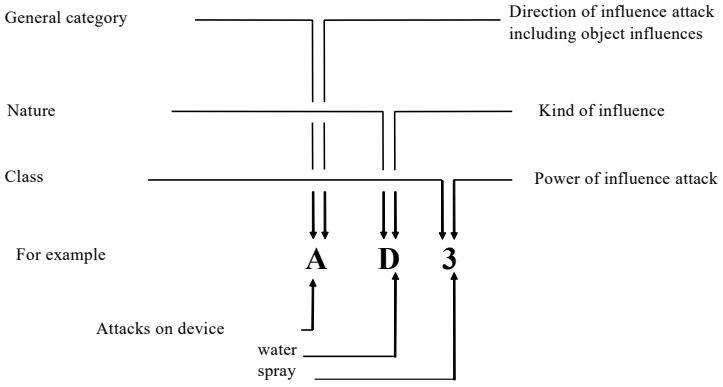
The first characteristic number: it means the protection degree against getting solid foreign figures into.

The second characteristic number: it means the protection degree against getting water into

Examples of IP code: IP 21, IP 42, IP 43, IP 44, IP 55, IP66.

12.3.2. External influences

Surroundings of each of electrical devices attack it. This attacking is defined as external influences. It is necessary to choose and install electrical devices in compliance with requirements which are defined in relevant electrical regulation for guarantee of basic conditions of safety (persons, animals and property) at operational reliability (at defined way of operation). External influences by their presence also predetermine single spaces from a danger of electrical current injury, electric or electromagnetic field point of view (Meduna, V., Kocman, S.: Safety in electrical engineering). The external influences define the degree of IP code. External influences are classified into three levels. Each level of outside impact is labelled by two letters of big alphabet and a number.



12.3.3. Space division

- from electric current injury point of view
  - Normal (external influences decrease the danger of electrical current injury): AA4, AB5, AC1, AD1, AE1, AF1, BA1, BC2…..
  - Dangerous (by influence of environment the risk of injury is permanent or temporary): AA6, AB1, AE3, AF2, AM2, BA2, BC3…..
  - Extremely dangerous (special circumstances or external influences increase the danger of electrical current injury): AB6, AD4, AF4, AG3, AH3….

Spaces	Allowed limits of safe extra-low voltage (V)	
	AC	DC
Normal and dangerous Active parts Inactive parts	25 50	60 120
Extremely dangerous Active parts Inactive parts	- 12	- 25

12.4. Types of electrical protective equipment, application examples

- Protection by safe extra-low voltage
- Protection by insulation
- Protection by covers or dividers
- Protection by location in a space
- Protection by automatic disconnecting from source
- Protection using of devices with additional isolation
- Protection by non-conducting environment
- Protection by non-earthed equipotential local bonding
- Protection by electrical separating

Protections against electrical current injury are in a harmony with knowledge of electrical current affecting on human organism and are established on principles as follows: to prevent the dangerous touch, to restrict of body current to safe value, timely automatic disconnecting from source (Meduna, V., Kocman, S.: Safety in electrical engineering).

12.5. First aid for electrical shock

The rules for the first aid

- To move away the affected person from the reach of electric current by switching off or by reliable breaking the electric circuit where the affected person is located
- If the affected person is in coma, it is necessary to find out if the person breathes with palpable puls
- If the pulse of the affected person is not palpable nad doesn't breathe, it is necessary to give the indirect hearth massage and the mouth to mouth breathing besides to
  - At adults 30 pressings repeatedly with a frequency of 100 per minute and after 2 breaths
- Call the doctor (recommended already at point 2)
- Inform the supervisor

Indirect hearth massage

The palm of the hand is laid approx. 3 cm above the breastbone. The palm of the second hand is laid on the wrist of the first hand and the fingers of both the hands are fastened. The rescuer should bend over the injured person so that the press of the breastbone 4 – 5 cm deeply with hands stretched out could be possible. The breastbone releases after the press. This is done fluently with frequency 100 pulses per minute (30 pressings) and after 2 breaths. The massage is done till the pulse is palpable or until the doctor comes (Kocman S. et all: The work safety in FEI laboratories).