EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání

MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY

12. OPERATING SAFETY OF ELECTRICAL DEVICES



Doc. Ing. Stanislav Kocman, Ph.D.

22. 5. 2018, Ostrava

LECTURE PLAN

- definitions, basics, qualified persons
- basic requests for safe work with electrical devices
- IP code, external influences
- types of electrical protective equipment, application examples
- first aid for electrical shock

Definitions, basics, qualified persons

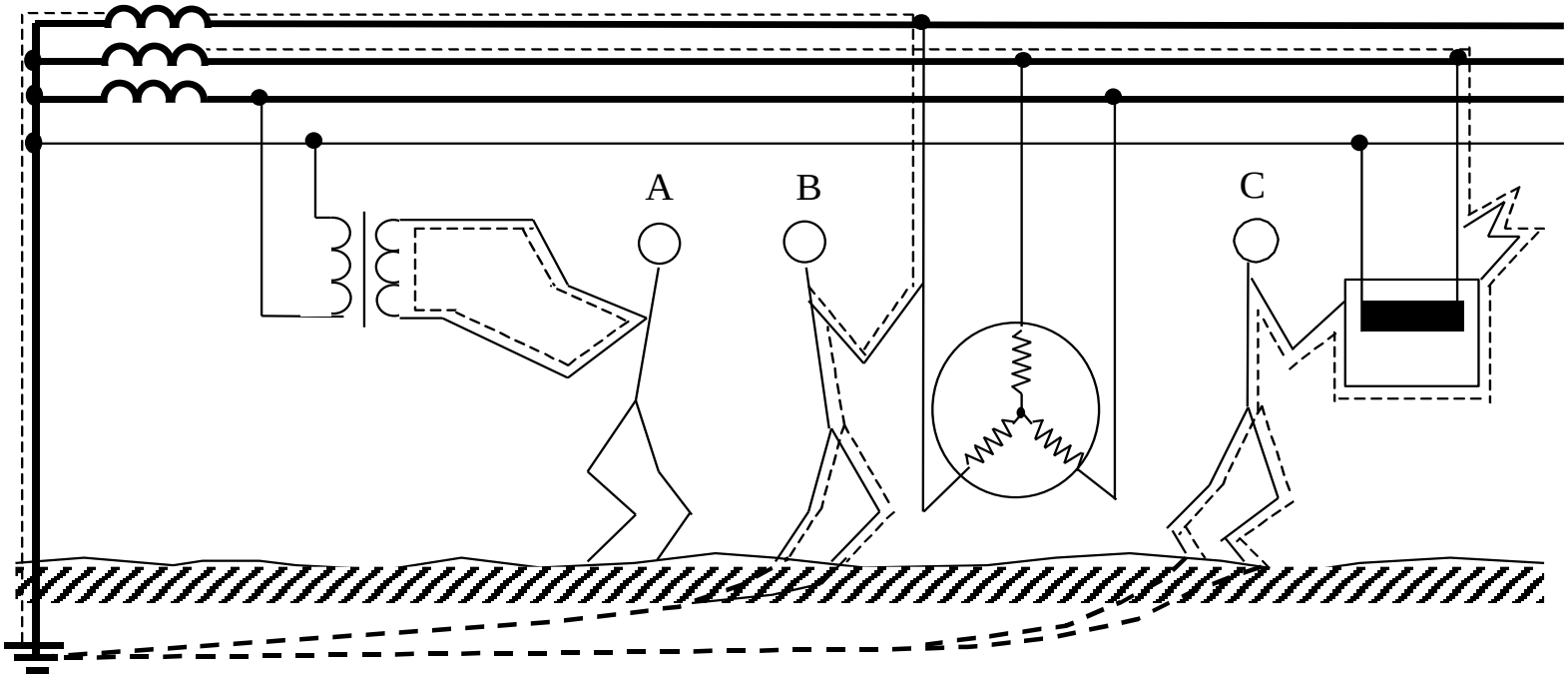
Basic definitions

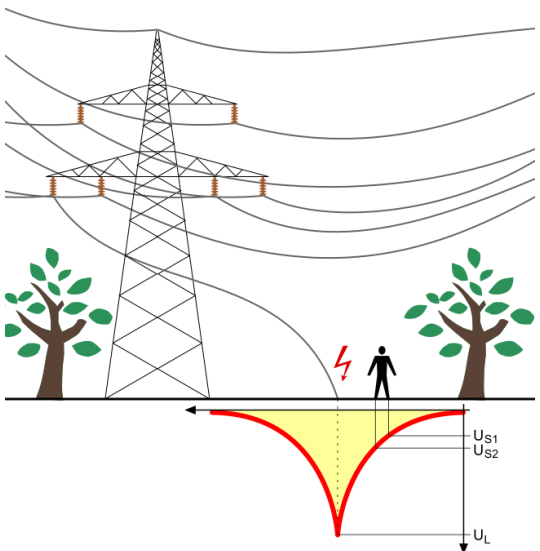
- **The operation (service) of the electrical devices:**
  - **switching on - off, regulation, reading values of permanently mounted apparatus, the change of screwed and internal apparatus fuses, bulbs, the inspection of apparatus**
- **The work on the electrical devices:**
  - **mounting, revision, service the electrical devices, measuring with portable apparatus**

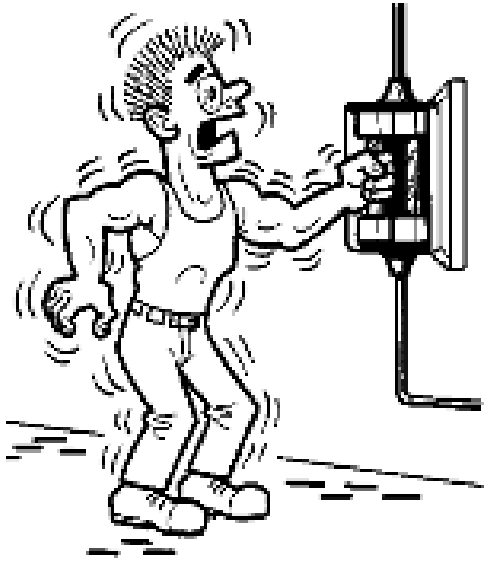
Basic definitions

- **The active part of electrical device:**
  - **conductor or conducting part determined for being energized during usual operation**
- **The inactive (exposed) conductive part:**
  - **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**

Examples of dangerous contact







Qualified persons

- **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**

Basic requests for safe work with electrical devices

- **for persons:**
  - **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**

Basic requests for safe work with electrical devices

- **for devices:**
  - 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



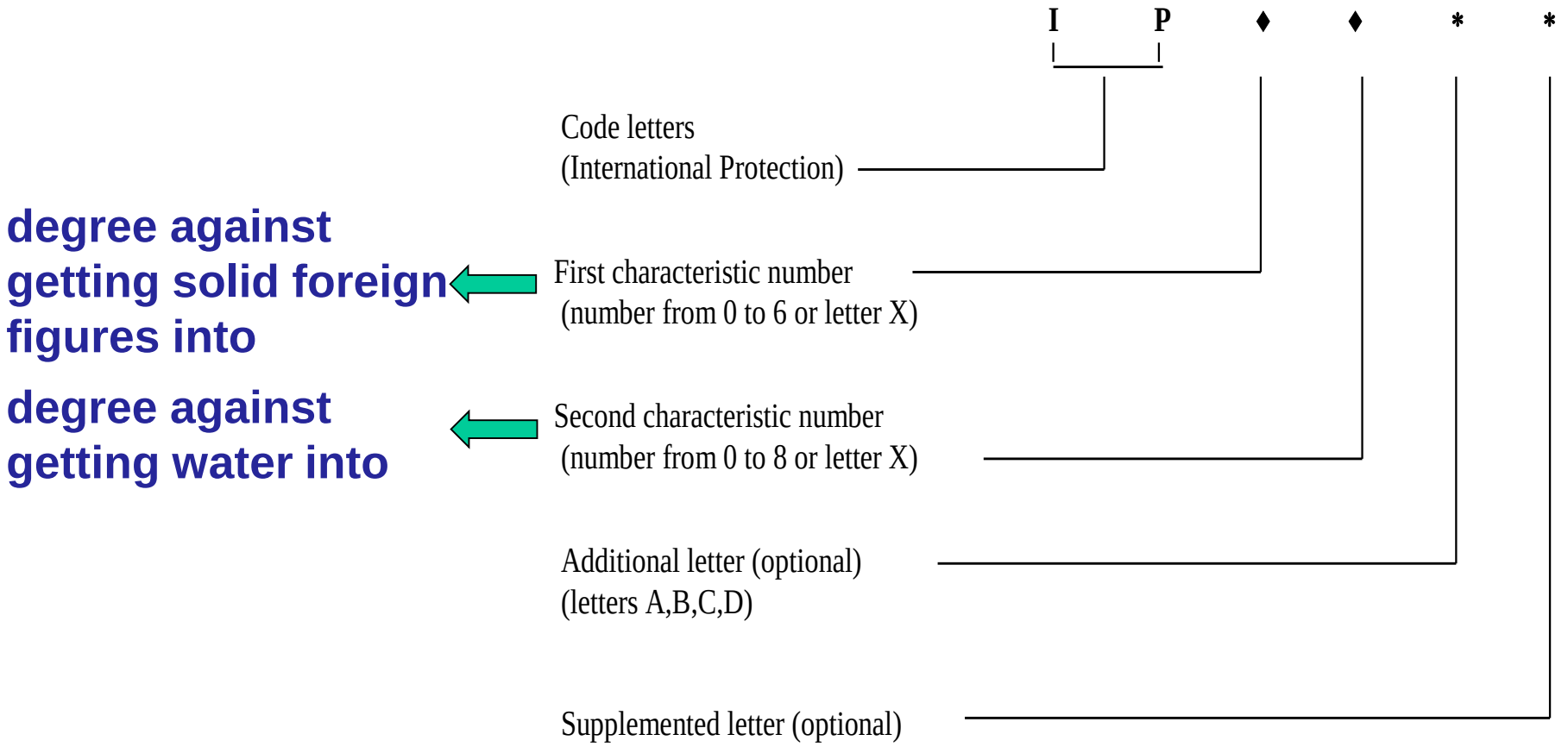




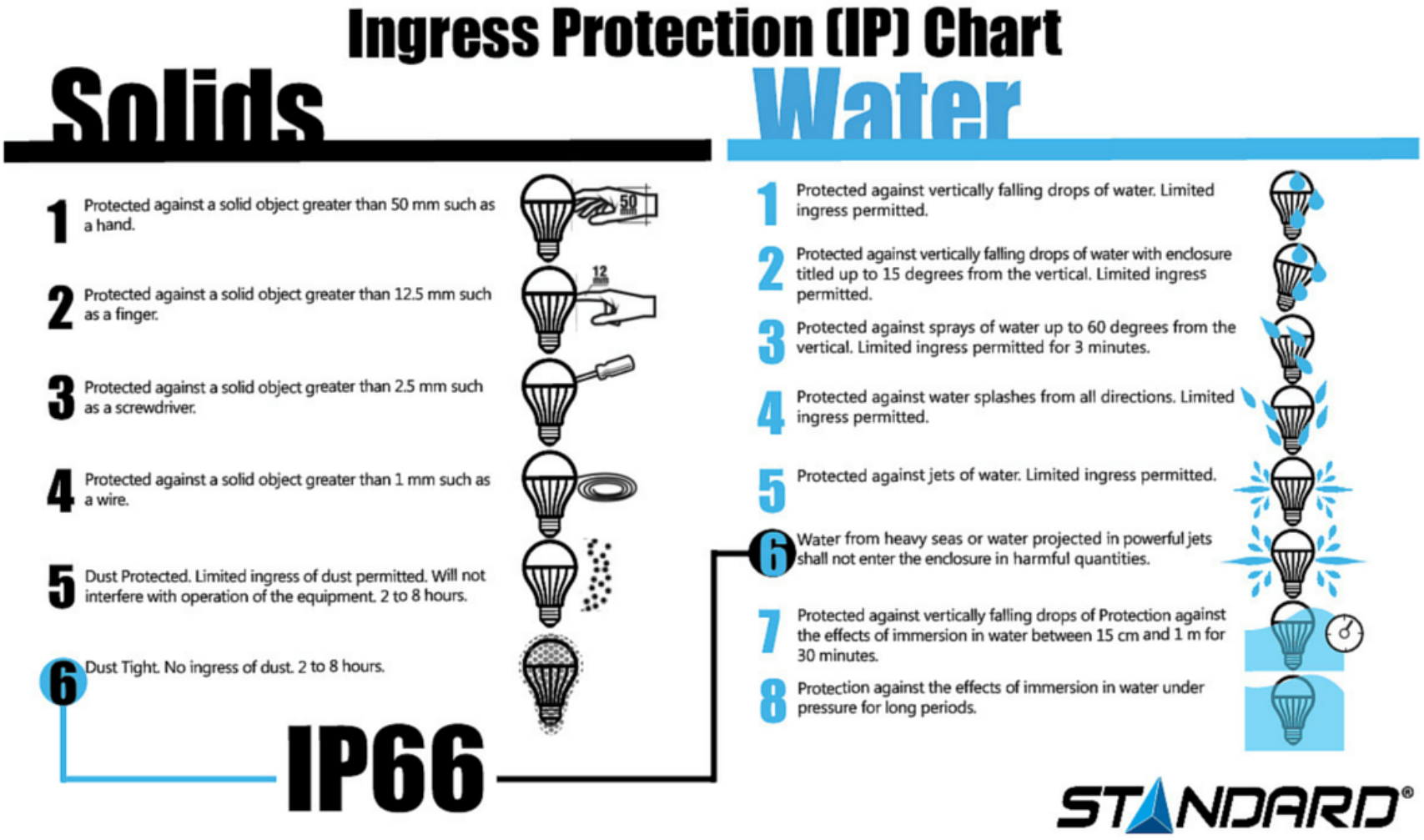
IP code, external influences

IP code

- **marks degrees of a cover protection:**



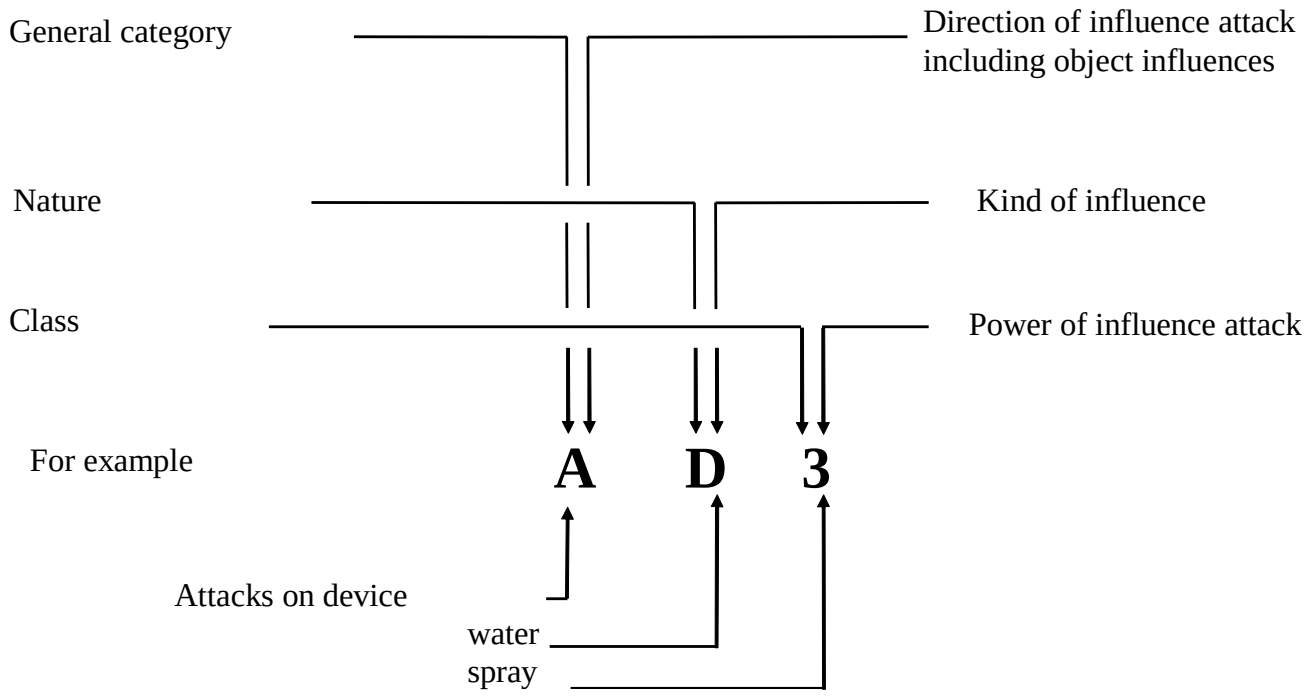
IP code



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

External influences

- **Taken into account when**
  - **To ensure the safety of persons**
  - **To ensure the protection of devices**
- **The external influences define the degree of IP code**
  - **Combination of two letters and number**



External influences

- **The first letter (A,B,C)**
  - **A: environment**
  - **B: utilization**
  - **C: construction of buildings**
- **The second letter (A,B,C,D,E,F,G,H,K,L…): under A**
  - **A: ambient temperature**
  - **B: atmospheric humidity**
  - **C: altitude**
  - **D: presence of water**
  - **E: presence of foreign solid bodies or dust**
  - **F: presence of corrosive or polluting substances**
  - **G: mechanical shock**
  - **H: vibrations**
  - **K: presence of flora and/or molds growth**
  - **L: presence of fauna**
  - **S: wind**

External influences

- **The second letter (A,B,C,D,E): under B**
  - **A: capability of persons**
  - **B: electrical resistance of human body (under consideration)**
  - **C: contact of persons with earth potential**
  - **D: condition of evacuation in case of emergency**
  - **E: nature of processed or stored materials**
- **The second letter (A,B): under C**
  - **A: construction materials**
  - **B: building design**
- **The number**
  - **relates to the class within each external influence**
- **Examples**
  - **AD3 (sprays: IPX3)**
  - **AE4 (light dust: IP5X)**
  - **BA2 (children)**

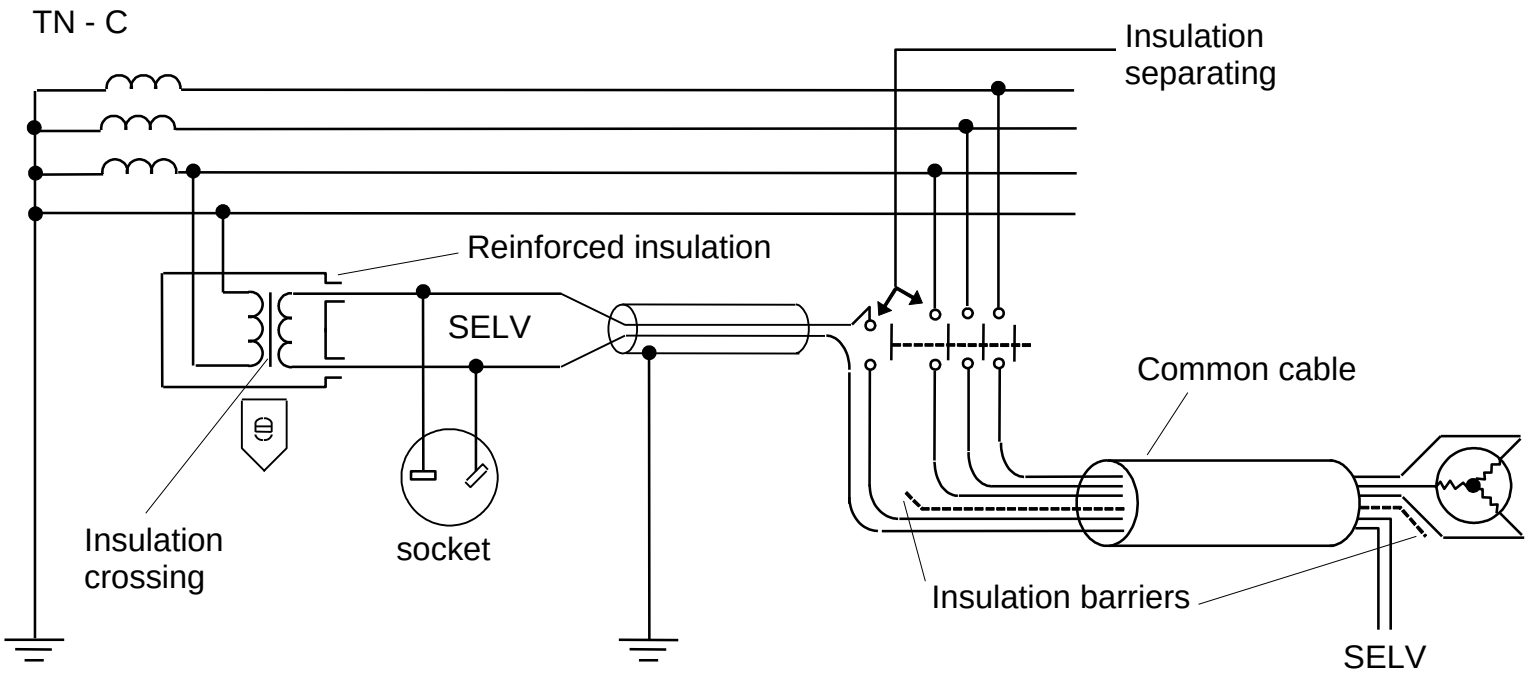
Space division

- **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….**
- **Limits of safe extra-low voltages**

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

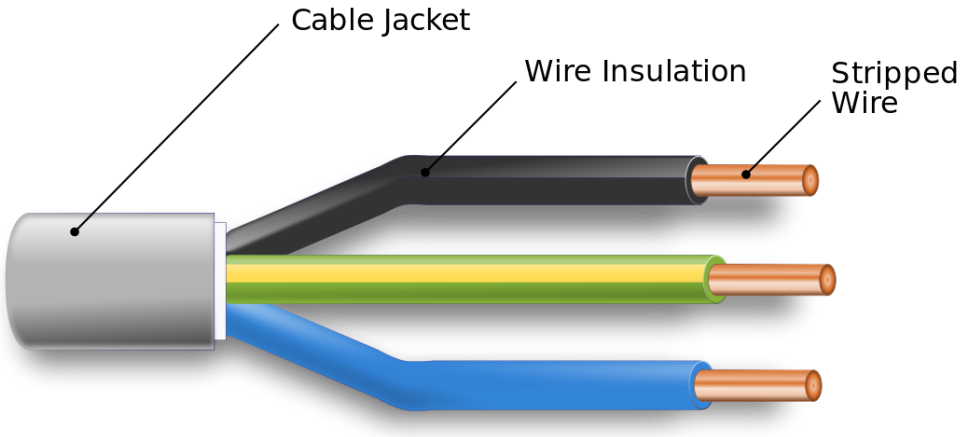
Types of electrical protective equipment

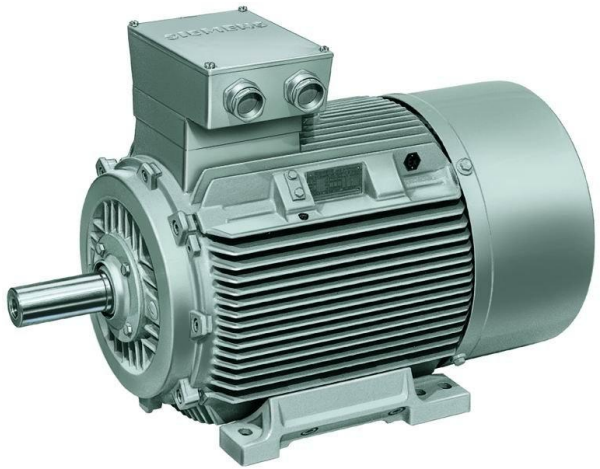
- **Protection by safe extra-low voltage**
  - **Circuit SELV : active parts must be separated reliably electrically from other circuits**
  - **Circuit PELV : some part of circuit is grounded from operational reasons**



Protection against dangerous touch of active parts

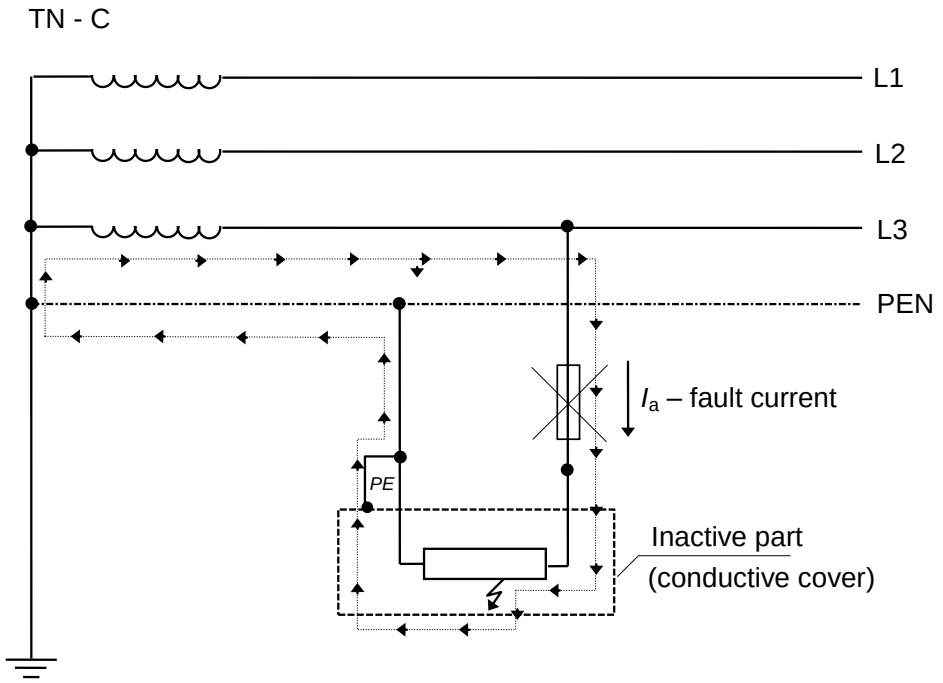
- **with isolation:**
  - **complete covering of active parts by isolation : isolation of conductors**
- **by covers or dividers:**
  - **protection against active parts touch in all directions (cover)**
  - **protection from each usual directions of access (divider)**
- **by location in a space**





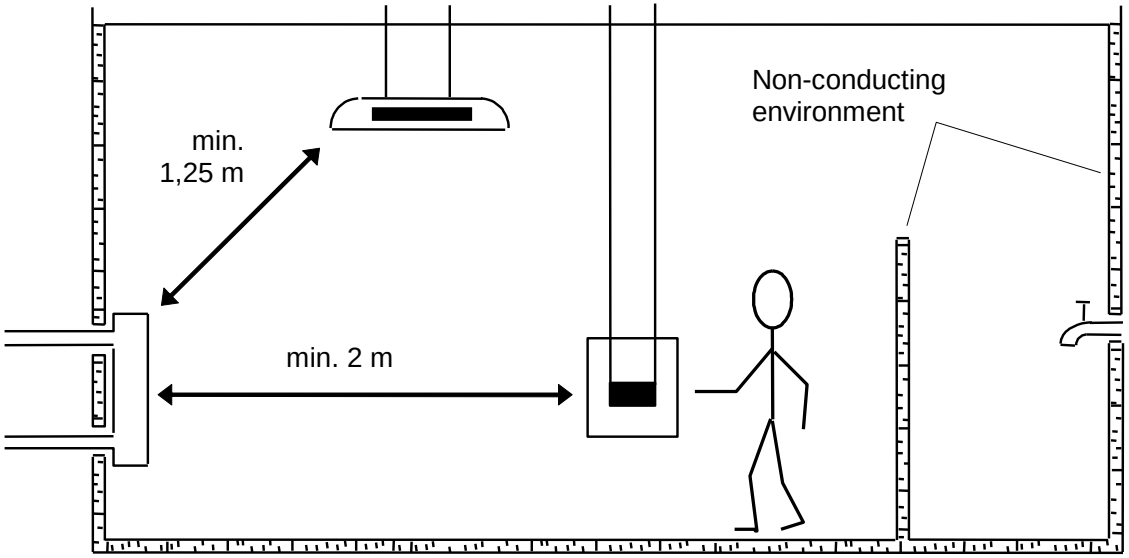
Protection against dangerous touch of inactive parts

- **protection by automatic disconnecting from source:**
  - **connecting of inactive parts by protective conductor with source node**
  - **performance of main bonding (connecting of protective conductor with building construction, pipeline and grounding)**



Protection against dangerous touch of inactive parts

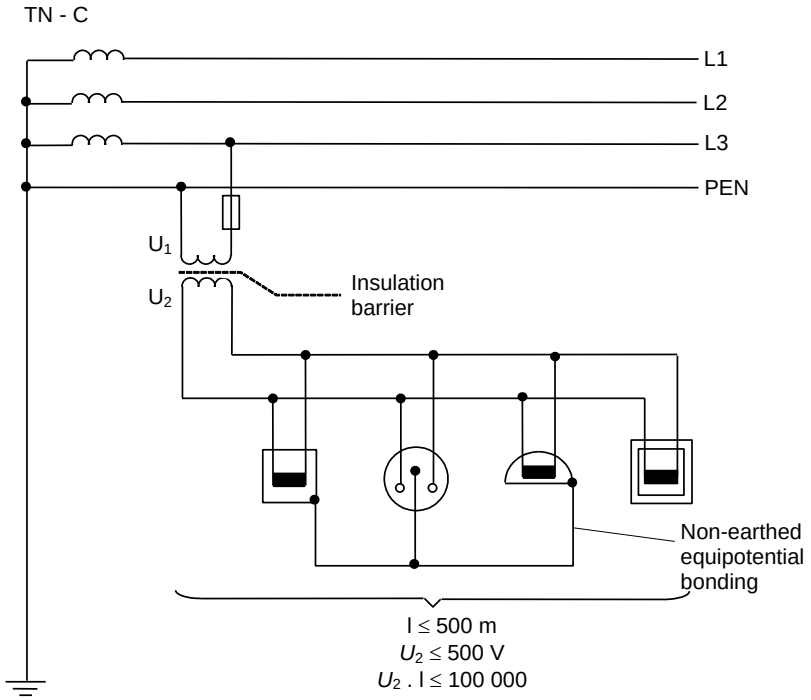
- **using of devices with additional isolation:**
  - **Electrical device of class II is performed with double isolation**
- **protection by non-conducting environment:**



- **protection by non-earthed equipotential local bonding**

Protection against dangerous touch of inactive parts

- **protection by electrical separating:**
  - **circuit must be supplied via isolation protective transformer**
  - **voltage of electrically separated circuit must not exceed 500 V**
  - **active parts of separated circuit must not be connected with another circuit or with ground in any point**



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

First aid for electrical shock



