RULES FOR THE INSTALLATION OF ELECTRICAL LINES AND WIRING

I. GENERAL PROVISIONS

1. The *Rules for the Installation of Electrical Lines and Wiring* (hereinafter – the Rules) establish the requirements for the installation of overhead and cable electrical lines, electrical wiring, and conductors with voltages up to and including 400 kV in electrical systems.

2. The requirements of the Rules are mandatory for electricity producers, transmission and distribution network operators, and electricity consumers who are installing new, reconstructing, or performing major repairs on electrical equipment. The Rules apply to individuals whose activities are regulated by the Law on Construction of the Republic of Lithuania.

3. These Rules do not apply when overhead electrical lines and conductors are installed according to specialized regulations or other normative legal acts (e.g., for electric traction contact networks, automatic blocking signal lines, etc.), as well as for the installation of special conductors for electrolysis equipment and networks for electrothermal equipment.

4. Terms and abbreviations used in the Rules:

- **Oil-filled cable line** – a cable line filled with oil, where the long-term permissible oil pressure is 0.025–0.294 MPa (0.25–3.0 kg/cm²) in low-pressure cables with lead sheaths, 0.025–0.49 MPa (0.25–5.0 kg/cm²) in low-pressure cables with aluminum sheaths, and 1.08–1.57 MPa (11–16 kg/cm²) in high-pressure cables.
- **Lighting conductor** – a conductor intended for supplying electricity to luminaires and other low-power electrical devices.
- **Lighting busbar** – a busbar intended for supplying luminaires and low-power electrical devices.
- **Partition** – a metal mesh structure, panel, etc., that separates part of a room or space, without a temperature difference between the separated areas.
- **Tower** – a reinforced concrete, metal, or wooden structure (or a combination thereof) that supports overhead line conductors and ground wires.
- **Branch tower** – a tower where the overhead line branches.
- **Electrical line** – a part of an electrical engineering network or system, which may consist of cables, conductors, insulators, and supporting structures used to transmit electricity.
- **Electrical technician** – a person who installs and/or operates electrical engineering facilities and equipment under an employment or other contract.
- **Clearance span** – the distance between two towers, limited by the standardized vertical distance from the ground surface to the conductors, assuming the towers are placed on perfectly level ground.
- **Terminal tower** – a tower located at the beginning or end of an overhead line, or at points where cable sections terminate, designed to withstand unidirectional tension from conductors.

- **Sag** – the vertical distance in an overhead line span between the conductor (ground wire, aerial cable) and the straight line connecting the suspension points.
- **Anchor tower** – a tower installed at specified intervals to withstand longitudinal forces acting along the line.
- **Outdoor installation** – an electrical engineering network located on the exterior of buildings or structures. It includes exposed and concealed outdoor wiring.
- **Branching device** – a location (chamber) where a steel pipeline ends and terminal joints are installed.
- **Cable** – an insulated conductor or group of conductors protected from external influences by a sheath or sheath and protective covering.
- **Cable line (CL)** – a part of an electrical engineering network intended for transmitting electricity or low-voltage signals, consisting of one or more parallel aerial or underground cables with connecting, sealing, and terminal joints. Oil-filled lines also include oil supply devices and pressure signaling systems.
- **Cable floor** – a part of a building designated for cable routing, with a minimum height of 1.8 m.
- **Cable block** – a structure with channels for cable routing and wells for maintenance.
- **Cable trestle** – a long open, horizontal or inclined engineering structure for cable routing. It may be walkable or non-walkable, installed on the ground or elevated.
- **Cable gallery** – a long engineering structure for cable routing, with a roof and walls (enclosed) or without side walls (open), horizontal or inclined. It may be installed on the ground (enclosed) or elevated.
- **Cable chamber** – an underground structure with a removable cover for cable routing, intended for installing cable joints or pulling cables into blocks. A chamber with an access hatch is called a cable well.
- **Cable engineering structure** – a specialized engineering structure for installing cables, cable joints, oil-filled cable lines, oil supply devices, and other equipment to ensure proper operation. These include cable tunnels, channels, trestles, galleries, chambers, oil supply points, etc. Cable shafts, cable floors, and double floors are not considered cable engineering structures and are parts of other buildings or constructions.
- **Cable channel** – an enclosed structure with a removable cover for cable routing, fully or partially embedded in soil, floors, ceilings, etc.
- **Cable shaft** – a vertical enclosed part of a building, with a height several times greater than its width, equipped with brackets or ladders for cable mounting, or a structure with a removable enclosure.
- **Cable tunnel** – an enclosed underground engineering structure with shelves for cable routing and a longitudinal corridor for maintenance and repair.

- **Chamber** – a room or part of a room in a building where equipment and busbars are installed.

- **Angle tower** – a tower installed at turns in the overhead line route, designed to withstand the restoring force from conductor tension in adjacent spans.

- **Main conductor** – a conductor intended for transmitting electricity to power distribution points, switchboards, and individual high-power electrical receivers.
- **Non-urbanized area** – fields, gardens, orchards, forests, and areas with scattered or temporary structures.
- **Aerial cable (AC)** – twisted insulated phase conductors, reinforced or unreinforced, and a reinforced, insulated or uninsulated neutral conductor.
- **Aerial cable line (ACL)** – an electrical engineering network designed to transmit electricity via aerial cables installed in open air and attached to towers or building structures.
- **Overhead line (OHL)** – an electrical engineering network designed to transmit electricity via uninsulated or insulated conductors installed in open air and attached to insulators on towers.
- **Oil supply unit** – an automatically operating device consisting of tanks, pumps, pipes, control valves, vents, an automation panel, and other equipment used to supply oil to high-pressure cable lines.
- **Oil supply station** – an above-ground or underground structure equipped with oil supply devices (supply and pressure tanks, oil supply units, etc.).
- **Attic** – the space between the top floor ceiling, walls, and the roof of a building.
- **Crossing tower** – a tower where two directions of OHL or ACL intersect.
- **Crossing** – a span of an OHL that crosses other electrical, communication, broadcasting lines, roads, railways, etc.
- **Distribution conductor** – a conductor intended for transmitting electricity to low-power electrical receivers.
- **Conductor** – a device for transmitting electrical energy, consisting of insulated or uninsulated conductors and supporting insulators, protective covers, and supporting structures.
- **Electrical engineering system of a building (internal wiring)** – an electrical engineering network inside buildings, consisting of wires, cables, fastening elements, protective structures, and components. Includes exposed or concealed internal wiring.
- **Pole** – the vertical reinforced concrete, metal, or wooden element of an OHL tower, used to support conductors and structures.
- **Strand** – a steel wire stretched close to walls, ceilings, or other surfaces, used to fasten wires and cables.
- **Mount** – a structure used to fasten wires, installed on building roofs, coverings, walls, etc.
- **Hard-to-reach area** – an area inaccessible to road vehicles and agricultural machinery.
- **Span** – the horizontal distance between the axial lines of two adjacent towers.
- **Intermediate tower** – a tower installed in a straight section of an OHL route between anchor towers, designed to withstand the weight of conductors, ground wires, ice, and wind loads.
- **Transposition tower** – a tower used to change the arrangement of phase conductors.
- **Trolley conductor** – a conductor used to transmit electricity to moving electrical receivers.
- **Urbanized areas** – residential areas of cities, towns, and densely built-up villages with structures.
- **Low-pressure oil-filled cable line section** – a section of a cable line between sealing joints or between a sealing and terminal joint.

Other terms used in the Rules are understood as defined in the **Law on Energy of the Republic of Lithuania**, the **Law on Electricity of the Republic of Lithuania**, the **General Rules for the Installation of Electrical Equipment** approved by Order No. 1-22 of the Minister of Energy of the Republic of Lithuania on February 3, 2012, and other legal acts regulating the installation of electrical equipment.

VI. OVERHEAD LINES WITH VOLTAGE ABOVE 1000 V

I. GENERAL REQUIREMENTS

312. The mechanical strength of conductors, insulators, fittings, overhead line towers, and their foundations must be calculated using the limit state method based on actual loads. The use of other calculation methods must be justified in the project documentation.

313. The need for phase transposition in substations for overhead lines up to 35 kV is determined by design decisions. For overhead lines of 110–400 kV longer than 100 km, one complete (symmetrical) transposition cycle must be performed.

314. A cleared strip of land at least 2.5 meters wide must be maintained along and accessible to 110 kV and higher voltage overhead lines. This strip must be free of vegetation, stumps, and stones. Exceptions apply in the following cases:

> **314.1.** In swampy and highly rugged areas where vehicle access is impossible. In such areas, pedestrian paths at least 0.8 meters wide with footbridges must be installed along the line route.
>
> **314.2.** In orchards, valuable crop areas, and vegetation zones intended to protect railways and roads from snow.

315. Overhead lines must be routed away from rivers, avoiding constantly eroded banks, potential riverbed shifts, flood-prone areas, and places where water flows, ice drift, or other hazards may occur (e.g., ravines, floodplains). If towers cannot be placed away from such areas, they must be protected against damage using special foundations, bank and slope reinforcements, drainage ditches, ice barriers, or other structures. Towers must not be installed in landslide-prone zones. The highest water level from ice drift and flooding is determined with a 2% probability (recurrence once every 50 years) or based on observation data.

316. Permanent markers must be installed on overhead line towers at a height of 1.7–3 meters:

> **316.1.** Serial number on all towers.
>
> **316.2.** Line number or designation (name), warning sign on the first tower of the line and branch towers, towers at intersections of lines with the same voltage, towers on both sides of crossings with railways and national roads (main, regional, and local), and on all towers of parallel lines if the distance between their axes is less than 200 meters. Each circuit must be marked on double- and multi-circuit towers.
>
> **316.3.** Signs indicating the distance from the tower to the communication cable line must be placed on towers located less than half the tower height from the cable.
>
> **316.4.** Adhesive signs must not be used on the exterior of structures.
>
> **316.5.** Signs installed on towers near roads must be sized so as not to distract drivers.

317. Metal towers and all metal components of reinforced concrete towers must be protected against corrosion. They must be coated with corrosion-resistant metals (zinc, aluminum-zinc) or made from corrosion-resistant materials. Overhead line towers must be grounded. Grounding requirements are provided in the *General Rules for the Installation of Electrical Equipment* (GRIEE).

318. Substations must be equipped with special devices to locate faults in 110 kV and higher voltage overhead lines. If such lines are installed in regions where ice buildup on surfaces reaches 20 mm or more and occurs frequently, devices signaling ice formation must be installed.

319. When designing overhead lines, swampy areas, landslide zones, areas with heavy icing, strong winds, etc., must be avoided. Route selection must be justified by comparative technical and economic calculations.

II. CLIMATIC CONDITIONS

320. Climatic conditions for calculating overhead line (OHL) structures must be determined based on icing and wind zone data for the territory of the Republic of Lithuania, as well as the requirements provided in Figures 1 and 2 of Annex 2 of the Rules, the construction norms *"Construction Climatology. RSN 156-94"*, approved by Order No. 76 of the Minister of Construction and Urban Development of the Republic of Lithuania on March 18, 1994, and the technical construction regulation *STR 2.05.04:2003 "Actions and Loads"*, approved by Order No. 233 of the Minister of Environment of the Republic of Lithuania on May 15, 2003. In cases where different values for climatic conditions are presented, the strictest requirements from these legal acts must be applied.

321. The design (maximum) values for wind pressure and the thickness of ice and frost layers for overhead lines (OHL) with voltages from 6 to 400 kV must be:

321.1. For 6–10 kV OHL – recurring once every 10 years;

321.2. For 35 kV and higher voltage OHL – recurring once every 25 years.

322. The maximum wind speed recurring once every 10 and 25 years at a height of 10 meters above ground level in non-urbanized areas must be determined according to normative standards.

323. Wind pressure correction coefficients for heights other than 10 meters in open (non-urbanized) areas, urbanized areas, or areas with obstacles higher than 10 m and up to 25 m, and in cities or areas with obstacles higher than 25 m, are provided in Table 1 of Annex 2 of the Rules. Wind pressure on OHL conductors must be calculated at the recalculated height of the center of gravity of all conductors, and wind pressure on ground wires – at the center of gravity of the ground wires, determined by the formula:

$$h_p = h_v - \frac{2}{3} f \; ; \qquad (3)$$

Where:

- **hv** – average height of conductor attachment to insulators or average height of ground wire attachment to towers, measured in meters from the ground surface at the tower installation site;
- **f** – maximum sag of the conductor or ground wire in meters, under the highest temperature or under icing without wind.

Wind pressure (speed) at intermediate height points not listed in Table 1 of Annex 2 is determined by linear interpolation.

324. The maximum equivalent thickness of ice that may form on conductors with a diameter of 10 mm at a height of 10 m above ground must be selected according to established norms. Based on long-term observation data and the nature of past failures, the ice thickness at the line construction site is refined during the design phase. When selecting insulated conductors for OHL in the third icing zone, the design ice thickness must be determined as for the second icing zone, and in the fourth zone – as for the third (reduced by one icing zone).

325. Wind pressure on tower structures is determined based on the height of the midpoint of the zone above ground level. Correction coefficient values are determined according to Table 1 of Annex 2 of the Rules.

326. For OHL sections installed in urbanized areas, the maximum normative wind pressure is adjusted using correction coefficients provided in Table 1 of Annex 2 for location types B and C. Normative wind pressure is also adjusted if local observations or measurements show significant deviations from the normative values (e.g., slopes, forests, etc.).

327. When calculating wind pressure on conductors and ground wires, the wind direction is assumed to be perpendicular to the OHL. For tower calculations, wind direction is considered at angles of 90°, 45°, and 0° to the OHL.

328. The normative wind load on conductors and ground wires, under wind pressure q (kPa/m²) and wind blowing at an angle α to the conductor (or ground wire), for each design condition is determined by the formula:

$$P_v = \alpha * K_l * C_x * q_v * F * \sin^2 \varphi, \text{ kPa}; \qquad (4)$$

Where:

α **–** coefficient accounting for wind pressure unevenness in the OHL span, equal to:

- 1.0 – when wind pressure is up to 0.27 kPa/m²;
- 0.85 – when wind pressure is 0.40 kPa/m²;
- 0.75 – when wind pressure is 0.55 kPa/m²;
- 0.70 – when wind pressure is 0.76 kPa/m² or higher Intermediate values are determined by linear interpolation.

K_l - Coefficient accounting for wind load dependence on span length, equal to:

- 1.2 – when the span length is up to 50 m;

- 1.1 – when the span length is 100 m;
- 1.05 – when the span length is 150 m;
- 1.0 – when the span length is 250 m or more. Intermediate K_l values are determined using linear interpolation.

C_x – Aerodynamic coefficient, equal to:

- 1.1 – for uniced conductors and ground wires with a diameter of 20 mm or more
- 1.2 – for all iced conductors and ground wires, as well as uniced conductors and ground wires with a diameter of less than 20 mm

q_v – Design wind pressure in kilopascals per square meter

F **–** longitudinal cross-sectional area of the conductor in square meters (taking into account the thickness of the ice layer when calculating load on iced conductors)

φ - Angle between the wind direction and the axis of the overhead line (OHL), in degrees.

329. Wind pressure and ice layer thickness on a 10 mm diameter conductor at a height of 10 m, when wind and icing events recur every 5, 10, and 25 years, must be considered and determined based on long-term meteorological observations and data from incidents caused by icing with wind in the territory of the Republic of Lithuania. Depending on local conditions (forest density, wind direction relative to the OHL during icing, terrain elevation, etc.), the ice layer thickness must be refined during the design phase.

330. The ice layer thickness on OHL conductors at heights other than 10 m must be determined by multiplying the ice thickness (for a 10 mm diameter conductor at 10 m height) by correction coefficients provided in Tables 2 and 3 of Annex 2 of the Rules. In clearance spans, the recalculated height of the center of gravity of conductors or ground wires (h_p) in meters is determined using formula (3).

331. The design density of ice on conductors and ground wires is 0.9 g/cm³.

332. When selecting insulated conductors for OHL in the second icing zone, the design ice thickness must be calculated as for the first icing zone; in the third zone – as for the second; and in the fourth – as for the third (i.e., reduced by one icing zone).

333. For OHL sections routed over hydroelectric dams or near cooling ponds, where observation data is unavailable, the ice thickness must be calculated 5 mm greater than required for the respective zone.

334. The design air temperature must be determined based on actual observation data or according to Clause 233 of the Rules.

335. For OHL with unbroken conductors and ground wires, calculations must be performed under the following climatic conditions:

335.1. Maximum temperature, no wind or icing

335.2. Minimum temperature, no wind or icing

335.3. Average annual temperature, no wind or icing

335.4. Conductors and ground wires iced, temperature −5 °C, no wind

335.5. Maximum normative wind pressure q_{max}, temperature −5 °C, no icing

335.6. Conductors and ground wires iced, temperature −5 °C, wind pressure 0.25 q_{max} (wind speed 0.5 v_{max})

335.7. In areas where ice thickness is 15 mm or more, wind pressure during icing must be no less than 0.14 kPa/m² (wind speed no less than 15 m/s)

336. For OHL with broken conductors or ground wires, calculations must be performed under the following climatic conditions:

336.1. Average annual temperature, no wind or icing

336.2. Minimum temperature, no wind or icing

336.3. Conductors and ground wires iced, temperature −5 °C, no wind

336.4. Conductors and ground wires iced, temperature −5 °C, wind pressure 0.25 q_{max}

337. When verifying OHL tower compliance with operational conditions, the following climatic conditions must be considered: temperature −15 °C, wind pressure at 15 m height above ground 0.625 kPa/m², no icing.

338. When calculating conductor proximity to OHL tower elements and structures, the following must be considered:

338.1. Maximum normative wind pressure q_{max}, at temperature −5 °C, under operating voltage (see Clause 355 of the Rules)

338.2. Wind pressure $q = 0.1\, q_{max}$ (wind speed ≈ 0.3 vmax), but not less than 6.25 daN/m², at temperature +15 °C, under either internal or atmospheric overvoltage's. Proximity must also be calculated when there is no wind

338.3. At temperature −15 °C, no wind or icing, and when safe climbing of the tower under voltage is required

The value of q_{max} is the same as used for determining wind pressure on conductors.

The **deflection angle** of conductors and ground wires in degrees is determined using the formula:

$$\operatorname{tg} \gamma = \frac{k \cdot P}{G_t + 0{,}5 G_g}; \quad (5)$$

Here:

- k – coefficient accounting for the dynamic oscillation of the conductor during deflection, equal to:
  - 1.0 – when wind pressure is up to 0.40 kPa/m²

- 0.95 – when wind pressure is up to 45 kPa/m²
- 0.90 – when wind pressure is up to 55 kPa/m²
- 0.85 – when wind pressure is up to 65 kPa/m²
- 0.80 – when wind pressure is 80 kPa/m² or higher *(Intermediate values are determined by linear interpolation)*

- P – normative wind load acting on the conductor, in decanewtons
- G – load from the conductor's weight on the insulator string, in decanewtons
- G_g – load from the weight of the insulator string itself, in decanewtons

III. CONDUCTORS AND GROUND WIRES

339. Overhead lines (OHL) are installed with one or more conductors per phase. A phase with multiple conductors is called a bundled phase. The diameter, cross-sectional area, and number of conductors per phase, as well as the spacing between conductors in a bundled phase, must be determined through calculation.

340. According to mechanical strength requirements, OHL must use stranded conductors and ground wires:

340.1. Conductor parameters must be calculated based on mechanical strength data provided by manufacturers.

340.2. Ground wires must be stranded steel ropes with a cross-sectional area of no less than 35 mm² and a minimum tensile strength of 0.12 kPa/mm². In critical crossings and areas with high chemical exposure, as well as when ground wires are used for lightning protection and high-frequency communication, or when required by thermal resistance conditions (see Clause 344), general-purpose steel-aluminum or special conductors must be used.

340.3. Self-supporting fiber optic cables may be installed on towers of OHL with voltages up to 330 kV in accordance with legal regulations.

340.4. Ground wires with fiber optic cables used in 110–330 kV OHL must meet or exceed the mechanical and thermal resistance requirements specified in Clause 340.2.

340.5. For lightning protection at OHL and railway crossings, steel ground wires must be used with a minimum tensile strength of 0.12 kPa/mm² and a cross-sectional area of at least 35 mm² in the first icing zone and 50 mm² in other zones.

341. Span lengths for 35–400 kV OHL must be determined based on the mechanical characteristics of conductors and towers provided by manufacturers, taking into account additional loads. For OHL with voltages of 10 kV and below, span lengths are determined according to technical documents approved by the distribution network operator (technical catalogs and construction rules). For 10 kV OHL with pin-type insulators, span lengths are determined according to technical normative documents. The cross-sectional area of steel-aluminum conductors in 10 kV OHL must be no less than 35 mm².

342. In areas where steel-aluminum conductors may be affected by corrosion (e.g., coastal zones, chemical plants, industrial areas), corrosion-resistant conductors must be used. If operational data is unavailable, the width of the coastal plain zone should be 5 km, and the zone around chemical plants should be determined based on local conditions.

343. At altitudes up to 1000 m above sea level, conductors must be selected according to corona discharge conditions as specified in Table 4 of Annex 2 of the Rules, or based on technical solutions considering local conditions. When selecting OHL design and the number of conductors per phase, as well as spacing between phases, the electric field strength on the conductor surface must be limited to acceptable levels for corona discharge and radio interference.

344. The thermal resistance of ground wires selected based on mechanical strength must be verified. Thermal resistance verification is not required in sections where the ground wire is attached to insulators.

345. Mechanical loads on conductors and ground wires in OHL with voltages above 1000 V must be calculated under the following conditions:

345.1. Maximum external loads

345.2. Minimum temperature with no external loads

345.3. Average annual temperature with no external loads

346. Mechanical calculations for OHL conductors and ground wires must use physical and mechanical characteristics provided by manufacturers.

347. Mechanical tension at the highest suspension points of steel-aluminum conductors must not exceed 105% of the values specified in the manufacturer's technical documentation. In all OHL sections, including major crossings, tension at the highest suspension points must not exceed 110% of the manufacturer's values, if permitted by the manufacturer.

348. OHL conductors and ground wires must be protected against vibration, in accordance with the requirements of technical documentation.

349. Conductors in bundled phases must be equipped with spacers in spans and anchor tower loops. The distance from the tower to the first spacer or spacer group must not exceed 75 m for uninsulated spacers and 40 m for insulated spacers. The spacing between individual spacers or spacer groups must comply with standards.

IV. ARRANGEMENT OF CONDUCTORS AND CABLES AND DISTANCES BETWEEN THEM

350. Overhead line (OHL) conductors on towers may be arranged in any order. For high-voltage OHLs, when conductors are arranged in multiple levels, the conductors of adjacent levels must be horizontally offset (see Rules 353–355). The distances between horizontally offset conductors of 110–330 kV voltage on intermediate towers must be determined according to the normative distances specified in Table 10 of Annex 2 of the Rules, and for 400 kV voltage – according to Table 9 of Annex 2. Horizontal offsetting of conductors between adjacent levels on all types of towers is not required if:

350.1. During the design phase, conductor galloping modeling shows that, under galloping conditions, there will be no intersections between conductors of different levels. The modeling must assume no more than two galloping waves (loops) per span;

350.2. The requirements of Rule 355 of these Rules are met;

350.3. Additional measures are planned to reduce the likelihood of conductor galloping.

In regions where the thickness of ice accretion on conductors is 15 mm or 20 mm, as well as in regions where conductor galloping is frequent, the conductors must be arranged horizontally. For high-voltage OHLs, when the thickness of ice accretion exceeds 20 mm, the conductors shall be arranged either horizontally or in a triangular configuration.

351. The distances between overhead line (OHL) conductors must be selected based on the operating conditions within the span, in accordance with the requirements of Rule 338 and the permissible insulation distances between conductors and tower elements. These distances are necessary to protect OHLs from overvoltage's and to ensure safe climbing of towers by personnel. The spacing between conductors, as well as between conductors and ground wires, must be determined based on span operating conditions, protection against atmospheric overvoltage's, and conductor sag corresponding to the design span. This must comply with the requirements of Rules 352–355 and overvoltage protection standards. In this case, the sag of the ground wire must not exceed the sag of the conductor. For individual spans selected during tower layout that exceed the design span by no more than 25%, it is not necessary to increase the conductor spacing calculated for the design span. For spans exceeding the design span by more than 25%, conductor spacing must be verified according to the requirements of Rules 352–354 and spacing between conductors and ground wires must be verified according to Rule 357 and overvoltage protection standards. In such cases, conductor spacing is determined using the formulas provided in Rules 352–354, without reference to Tables 6 and 7 of Annex 2 of the Rules.

352. For high-voltage OHLs with suspended insulators and horizontally arranged conductors, the minimum distance between conductors (denoted as d, in meters), based on approach conditions within the span, nominal line voltage, and maximum conductor sag, is determined using the following formula:

353. For high-voltage overhead lines (OHL) with suspension insulators and non-horizontal conductor arrangements on intermediate towers, when the conductor sag does not exceed 16 meters, the distances between conductors must be determined according to the operating conditions within the span.

353.1. In regions where conductor galloping occurs less frequently than once every 5–10 years, the distances between conductors are determined according to Table 6 of Annex 2 of the Rules. In such cases, for regions where the thickness of ice accretion is 5–10 mm, additional verification of icing conditions is not required. In cases where the distances cannot be determined according to Table 6 of Annex 2 (for example, when the vertical distance is less than specified in the table), the distance between conductors must be no less than the requirement for horizontally arranged conductors (see Rule 352). In regions where the thickness of ice accretion is 15–20 mm, the distances between conductors are determined according to Table 6 of Annex 2 and additionally verified using the following formula:

$$d = 1{,}0 + \frac{U}{110} + 0{,}6\sqrt{f} + 0{,}15h \; ; \qquad (7)$$

formula Parameters:

- U – Nominal voltage of the overhead line (OHL), in kV
- f – Maximum conductor sag corresponding to the design span, in meters
- h – Vertical distance between conductors, in meters

From the two distances—one determined according to Table 6 of Annex 2 and the other calculated using formula (7)—the greater value must be selected.

353.2. In regions where conductor galloping occurs once every 5 years, the vertical distance is determined according to Table 7 of Annex 2, without additional verification of icing conditions. In cases where the distances between conductors cannot be determined according to Table 7 of Annex 2, the spacing must be no less than the value calculated using formula (7).

353.3. In areas where conductor galloping occurs once every 5 years, and the OHL is protected from crosswinds by terrain features, forest masses, or structures with a height of at least two-thirds of the tower height, the conductor arrangement and spacing must be selected based on the data provided in Table 6 of Annex 2.

353.4. On intermediate towers, when the conductor sag exceeds 16 meters, the distances between conductors must be calculated using formula (7).

354. On anchor towers, the distances between conductors are calculated using formula (6). The minimum horizontal offsets between adjacent levels (tiers) of conductors on anchor towers must not be less than the values specified in Table 8 of Annex 2 of the Rules.

355. For all types of towers, horizontal offsetting of conductors is not required if the vertical distance between non-bundled conductors is greater than:

$d=0.8f+U250$ (8)

and between bundled conductors:

$d=f+U250$ (9)

Where:

- U – Nominal voltage of the overhead line (OHL), in kV
- f – Maximum conductor sag corresponding to the design span, in meters

Formulas (7), (8), and (9) are also applicable to 400 kV OHLs. In this case, the horizontal offset between conductors and ground wires must not be less than the values specified in Table 9 of Annex 2 of the Rules. In lines constructed in regions without icing, horizontal offsetting of conductors is not required, and the spacing between conductors for all types of towers is determined using the formula provided in Rule 352. When equipment is used to protect OHL conductors from galloping, the spacing between conductors is calculated using formula (6), and the horizontal offset between adjacent levels is determined according to Table 8 of Annex 2.

356. For 6–10 kV overhead lines (OHL) with pin-type insulators, regardless of the conductor arrangement, the distance between conductors—based on their approach conditions within the span—must not be less than the values calculated using the following formula:

$$d = \frac{U}{110} + 0{,}19\sqrt{fb}; \quad (10)$$

Here:

U – Nominal voltage of the overhead line (OHL), in kV

f – Maximum conductor sag corresponding to the design span, in meters

b – Thickness of ice accretion, in millimeters (for 6–10 kV OHL with pin-type insulators, d = 10 mm)

The distance between insulated conductors of the same circuit in 6–10 kV OHLs, both on towers and within spans, regardless of conductor arrangement and climatic region, must be no less than 0.4 meters.

357. The vertical distance between the ground wire and the conductor in 35–400 kV OHLs with one ground wire on towers for design spans is determined based on overvoltage protection conditions. In spans selected during tower layout that exceed the design span, towers are used where the distance between conductors and ground wires is selected according to the design span. In 35–400 kV OHLs with horizontally arranged conductors and two ground wires, the horizontal offset between the ground wire and the nearest conductor must be no less than:

357.1. 1 m – for 35 kV OHL

357.2. 1.75 m – for 110 kV OHL

357.3. 2.25 m – for 220 kV OHL

357.4. 2.75 m – for 330 kV OHL

357.5. For 400 kV OHLs on intermediate towers, horizontal offsets between the ground wire and the nearest conductor are specified in Table 9 of Annex 2 of the Rules

357.6. In 35–400 kV OHLs on anchor towers, the ground wire may be suspended above a horizontally non-offset conductor, provided such towers occur on average every two kilometers along the line.

359. On shared towers, 6–10 kV overhead lines (OHL) with insulated and uninsulated conductors, as well as optical cables (OC), may be installed together with 6–10 kV OHL conductors and OC, and with uninsulated conductors and OC of 1000 V and lower voltage OHLs. In this case, the OC for voltages up to 1000 V must be selected according to the design conditions applicable to 6–10 kV OHLs.

Additional requirements and conditions:

359.1. Insulated and uninsulated conductors of 6–10 kV OHLs must be installed above the OC of 1000 V and lower voltage lines. Both insulated and uninsulated conductors must be double-fastened. Insulated conductors must be fastened using two binding spirals, and uninsulated conductors must be double-fastened.

359.2. The vertical distance between OC of 1000 V and lower voltage and insulated conductors of 6–10 kV OHLs, on towers and within spans, at an air temperature of +15 °C and no wind, must be not less than 1.62 m; the distance between 6–10 kV OC and uninsulated conductors of 1000 V and lower voltage OHLs must be not less than 1 m.

359.3. The distance between 6–10 kV OC and OC of 1000 V and lower voltage must be not less than 0.3 m.

359.4. The distance between 6–10 kV OC and insulated conductors of 6–10 kV OHLs must be not less than 0.62 m. If the 6–10 kV OHL has uninsulated conductors, under the same conditions, this distance must be not less than 1.62 m. The same minimum distance applies between insulated and uninsulated conductors of 6–10 kV OHLs.

359.5. The vertical distance between insulated conductors of 6–10 kV OHLs and uninsulated conductors of 1000 V and lower voltage OHLs, on towers and within spans, must be not less than 1.62 m, at an air temperature of +15 °C and no wind.

V. INSULATION

360. In all overhead line (OHL) towers for 35 kV and higher voltages, and in terminal anchor and crossing towers of 10 kV OLs, only suspension insulators must be used. In other cases, for 10 kV and lower voltage OHLs, either suspension or pin-type insulators may be used.

361. For 10 kV OHLs, pin-type insulators must be used with a wet flashover voltage of no less than 40 kV. The ratio of the breakdown voltage to the flashover voltage for dry insulators must be no less than 1.5.

For 10–35 kV OHLs, the number of suspension insulators in a string must be:

- 2 insulators – for 10 kV OHLs
- 3 insulators – for 35 kV OHLs

Suspension insulator strings for 10–35 kV OHLs, and the type of pin-type insulators, are selected regardless of altitude above sea level.

362. For 110–400 kV OHLs, the number of glass suspension insulators in a string is selected based on reliable operation conditions. Additionally, the minimum specific leakage path length in areas with clean atmosphere must be no less than 1.3 cm/kV of the maximum voltage, considering the utilization efficiency coefficient of the insulator's leakage path in OHLs. The number of insulators in a string, determined based on the minimum specific leakage path condition, must be increased by one insulator for 110–220 kV OHLs, and by two insulators for 330–400 kV OHLs, to ensure sufficient insulation level in case one or two insulators fail. The insulator string selected based on operating voltage must be verified under switching overvoltage conditions (see Table 10 of Annex 2 of the Rules), if the ratio of the insulator's leakage path length to the string length exceeds 2.3.

363. Polymer rod-type insulators are selected based on:

- Leakage path length (considering local pollution levels)

- Mechanical strength requirements
- Manufacturer specifications

The number of glass suspension insulators in a string is determined according to the following requirements:

363.1. For 110 kV OHLs, the number of suspension insulators in tension strings must be increased by one insulator compared to the number in suspension strings.

363.2. On transition towers taller than 40 meters, the number of insulators in the string must be increased by one insulator for every additional 10 meters of tower height exceeding 40 meters.

363.3. For OHLs constructed in polluted areas, the type and quantity of insulators must be selected based on local environmental conditions.

364. The safety factor of insulator strength (i.e., the ratio of the insulator's destructive mechanical load to the maximum normative load) must be:

- Not less than 2.7 under normal conditions
- Not less than 5 when the average annual temperature is moderate, and there is no icing or wind, and no conductor or ground wire breakage

For OHLs with 400 kV voltage, the safety factor for suspension insulators must be not less than 2. For OHLs with 330 kV and lower voltages, the safety factor must be not less than 1.8, in cases where one or more conductors or ground wires have broken. The loads on insulators in cases of conductor or ground wire breakage must be determined according to Rules 341–343 and 345.

VI. LINE FITTINGS

365. Conductors must be fastened to suspension insulators and ground wires using supporting or tension clamps. Tension clamps must be of a type that does not require cutting the conductor. Conductors must be fastened to pin-type insulators using wire ties or special clamps.

366. Supporting clamps may be dead-end or with a limited-strength pin. Dead-end clamps are considered more reliable. Ground wires must be fastened to towers only with dead-end clamps. For large crossings, multi-rope hangers and special clamps are used.

367. Conductors and ground wires must be connected using connecting clamps or welding. Within a single OHL span, each conductor or ground wire may be connected no more than twice. The minimum distance between one connecting clamp and another clamp with a limited-strength pin must be at least 25 meters.

368. The strength of conductor and ground wire fastening in connecting and tension clamps must be no less than 90% of the conductor's or ground wire's ultimate tensile strength.

369. The safety factor for line hardware (i.e., the ratio of the minimum breaking load to the normative load applied to the hardware) must be:

- Not less than 2.5 when conductors and ground wires are intact
- Not less than 1.7 when one or more conductors or ground wires are broken

For hooks and pins, the safety factor must be:

- Not less than 2.0 when conductors and ground wires are intact
- Not less than 1.3 when one or more conductors or ground wires are broken

The loads acting on hardware, hooks, and pins in cases of conductor or ground wire breakage are determined according to Rules 373–375 and 377.

VII. TOWERS

370. Overhead line (OHL) towers for voltages above 1000 V are divided into two main types:

- Anchor towers – designed to withstand the tension of conductors and ground wires in adjacent spans.
- Suspension towers – do not withstand tension or withstand it only partially.

Anchor towers are used in straight sections, line turns, end points, and for conductor transposition (changing the arrangement of conductors). Depending on the number of suspended circuits, towers are classified as single-circuit, double-circuit, etc. Suspension towers must be constructed with flexible or rigid structures, while anchor towers must be rigid. Towers may be used with or without guy wires. For 110 kV and higher voltage OHLs, towers are generally used without guy wires, except in cases where:

- Temporary guy wires are needed during conductor and ground wire installation
- A temporary bypass connection is required

For 110 kV OHLs, single-pole anchor towers with reinforced concrete poles are used. The foundations and bases of towers must be designed in accordance with the standards and regulations of the Republic of Lithuania.

371. Tower structures must be calculated for both conditions:

- When conductors and ground wires are intact
- When one or more conductors or ground wires are broken

Anchor tower must be calculated based on the difference in tension forces of conductors and ground wires, which arises due to unequal equivalent span lengths on either side of the tower. The conditions for calculating this tension difference depend on the design of the tower.

In all tension scenarios, double-circuit towers must be calculated under the condition that only one circuit is installed.

Towers must also be verified for loads occurring during assembly and installation, including during conductor and ground wire mounting.

The metal elements of the towers must comply with the requirements of Rule 247.

372. OHL towers must be calculated under the following conditions:

> **372.1.** Conductors and ground wires intact, no icing, under maximum wind pressure and −5 °C temperature

372.2. Conductors and ground wires intact, with icing, under 25% of maximum wind pressure and −5 °C temperature (see Rule 335)

372.3. Anchor and intermediate angle towers must also be calculated under lowest temperature conditions without wind, if the tension force in conductors or ground wires under these conditions exceeds that of the maximum load scenario

372.4. Terminal towers must be calculated for unilateral tension of all conductors and ground wires, considering that conductors and ground wires are not installed on the substation side or the side of a neighboring span with a large crossing

373. Intermediate OHL towers with suspension strings and dead-end clamps must be calculated for horizontal static loads under the following conditions:

373.1. One conductor or one phase of conductors is broken (regardless of the number of conductors on the tower); ground wires are intact

373.2. One ground wire is broken; conductors are intact

373.3. Stress in calculated tower elements is determined by adding a conditional load at the attachment point of the broken conductor or ground wire, where the stress is greatest. Loads must be based on average operating conditions (no icing or wind)

373.4. For OHLs with non-bundled phases, calculate:

- 50% of maximum conductor loads for metal towers without guy wires and reinforced concrete towers with guy wires
- 40% of maximum conductor loads if conductor cross-section is 205 mm² or greater

373.5. For reinforced concrete towers without guy wires, calculate:

- 30% of maximum conductor loads, or
- 25% if conductor cross-section is 205 mm² or greater

373.6. For OHLs up to 330 kV with phases split into two conductors, multiply the values from 373.4 and 373.5 by:

- 0.8 for two conductors
- 0.7 for three conductors
- 0.6 for four conductors

373.7. For 400 kV OHLs with split phases, the normative conditional load at one phase conductor attachment point must be 15% of the maximum, but not less than 0.18 kPa

373.8. For intermediate towers using longitudinal load-limiting devices (e.g., limited-strength pins, blocks), calculate based on normative loads corresponding to these devices. The calculated load must not exceed the conditional load for dead-end clamps

373.9. Conditional horizontal load of the ground wire must be 50% of the maximum load

373.10. For flexible towers (reinforced concrete without guy wires), calculate load considering ground wire breakage and tower flexibility

373.11. Consider tower restraint by intact conductors and ground wires under average annual temperature without icing or wind. In this case, conditional normative loads must be applied to both metal towers without guy wires and reinforced concrete towers with guy wires, and mechanical stress in supporting conductors and ground wires must not exceed 70% of ultimate strength

374. Intermediate towers where conductors are fastened to pin-type insulators using wire ties must be calculated for longitudinal horizontal force equal to the tension force of one conductor, but not exceeding 0.15 kPa, under average annual temperature without icing or wind, when one or more conductors or ground wires are broken.

375. Anchor towers must be calculated for scenarios where the specific conductors and ground wires break, resulting in the maximum stress on tower elements. Calculations are based on the following cases:

375.1. For OHLs with aluminum conductors of any cross-section and steel–aluminum conductors up to 150 mm²:

- When two phase conductors break in one span and ground wires remain intact, regardless of the number of circuits on the tower (anchor towers)
- When one phase conductor breaks in one span and ground wires remain intact, for lighter anchor tower designs

375.2. When one phase conductor breaks in one span and ground wires remain intact, for OHLs with steel–aluminum conductors of 185 mm² or larger (anchor towers)

375.3. For anchor towers, regardless of conductor type or cross-section, when one ground wire breaks in one span and conductors remain intact

Conductor and ground wire loads are equal to their tension forces at −5 °C with icing and no wind, or at the lowest temperature, if the tension force under that condition exceeds the force at icing without wind.

376. Anchor towers must be verified under the following conditions:

376.1. All conductors and ground wires are installed in one span, and none in the adjacent span. The tension force in installed conductors and ground wires is 66% of the maximum tension force. Climatic conditions are defined by Rule 337. In this case, the tower and its foundation must meet the required strength standards without temporary guy wires.

376.2. In one span, conductors of a single circuit are installed one by one in any order, with no ground wires installed.

376.3. In one span, ground wires are installed one by one in any order, with no conductors installed.

376.4. For cases described in Rules 376.2 and 376.3, it is assumed that individual tower elements are temporarily reinforced with guy wires.

377. When calculating intermediate towers for large crossings with non-bundled phase conductors fixed with dead-end clamps, the normative load must equal the reduced tension force resulting from conductor breakage under icing and no wind. For bundled conductors, the normative load is reduced to:

- 80% of the maximum load for two conductors per phase
- 70% for three conductors per phase
- 60% for four conductors per phase

Additional requirements:

377.1. During conductor and ground wire installation, the longitudinal load is:

- 0.20 kPa for one conductor per phase
- 0.35 kPa for two conductors per phase
- 0.50 kPa for three or more conductors per phase

377.2. For single-circuit intermediate towers in large crossings, assume one conductor or all conductors of one phase are broken. For double-circuit lines, assume two phase conductors are broken, with maximum loads applied to calculated tower elements. Ground wires are assumed intact.

377.3. The normative load from a ground wire fixed with a dead-end clamp must equal the maximum tension force of the ground wire when conductors are intact.

377.4. Single-circuit anchor towers in large crossings with steel–aluminum conductors of 185 mm² or larger are calculated assuming one phase conductor or all bundled conductors of one phase are broken. For conductors under 150 mm², and for all double-circuit anchor towers, assume two phase conductors are broken, with ground wires intact.

377.5. The normative load from the ground wire on anchor towers in large crossings must equal the maximum tension force of the ground wire when conductors are intact.

377.6. When determining tower element loads, consider the maximum conditional loads or unbalanced stresses resulting from conductor or ground wire breakage.

378. OHL towers for voltages above 1000 V must be verified for loads corresponding to the installation method specified in the design, considering:

- Tension loads from pulling ground wires
- Weight components of installed conductors (or ground wires) and insulators
- Additional weight loads from electrical workers, equipment, and tools
- Cross-arm structures must include designated rigging attachment points.

Calculated weight loads of installed conductors (or ground wires) and insulator strings are determined as follows:

378.1. For intermediate towers, consider double the weight of the span's conductors (or ground wires) without icing and the insulator string, assuming they can be lifted with a single pulley block

378.2. For anchor towers, consider the pulling rope load, assuming the pulling mechanism is located 2.5 times farther from the tower than the height of the middle-phase conductor attachment point

378.3. At the insulator attachment point, the normative weight load from the electrical worker and equipment is:

- 0.25 kPa – for 400 kV OHL towers
- 0.2 kPa – for up to 330 kV anchor towers with suspension insulators
- 0.15 kPa – for up to 330 kV intermediate towers with suspension insulators
- 0.1 kPa – for towers with pin-type insulators

379. Each circuit of a double- or triple-circuit tension insulator string must be individually fastened to the tower. Tension strings with more than three circuits, and those on large crossing towers (over 700 m), must be fastened to the tower at no fewer than two points. For OHLs with suspension insulators and non-bundled conductors of 120 mm² or larger, at crossings with railways, main roads, urban streets, and trolleybus lines, tension strings must be double-circuit, with each circuit individually fastened to anchor towers. Conductors attached to pin-type insulators in urban areas and at crossings with engineering structures (as specified in Rules 399–452) must be double-fastened. Insulated conductors must be fastened using special spring ties.

380. The design of 110 kV and higher voltage overhead line (OHL) towers must allow for maintenance work to be performed without disconnecting the voltage.

381. Fixed climbing devices on towers must begin at a height of 3 meters above ground level. Tower elements must be verified for human weight load, equal to 0.1 kPa. The design of OHL towers must ensure that electrical maintenance personnel can comfortably climb the tower. For this purpose, the following features must be provided:

381.1. On metal towers up to 20 meters high, if the distance between adjacent cross-bracing connections on the tower leg exceeds 0.6 meters, or if the inclination angle of the bracing exceeds 30°, special steps must be installed on one leg of the tower.

381.2. On metal towers taller than 20 meters, special steps or ladders must be installed on one leg of the tower, reaching the top cross-arm. On double-circuit and multi-circuit metal towers, steps must be installed in such a way that climbing is possible on the side of the disconnected circuit.

381.4. There must be a possibility to ascend to the lower cross-arm of reinforced concrete towers using mechanized means. For 35–400 kV OHL towers, special steps must be installed on reinforced concrete poles to allow climbing above the lower cross-arm. This requirement does not apply to square-shaped 35 kV reinforced concrete towers. To enable climbing to ground wire poles and metal parts of 35–400 kV OHL reinforced concrete towers, special steps must be installed.

381.5. On reinforced concrete towers where vehicle-mounted lifts cannot access (e.g., difficult terrain, areas of intensive land cultivation, towers installed on embankments), or where ladders or special climbing equipment cannot be used (e.g., towers with guy wires or internal bracing below the lower cross-arm), fixed ladders without cages must be installed, reaching the lower cross-arm.

381.6. Tower design must ensure the possibility of mounting equipment using standardized components and allow technical personnel access to insulator string attachment points, enabling the installation of insulators, conductors, and ground wires.

382. The spacing between anchor towers is not regulated and is determined based on route conditions when:

- For 35 kV and higher voltage OHLs, conductors are suspended on intermediate towers using dead-end clamps or limited-strength pin clamps
- For 10 kV and lower voltage OHLs with pin-type insulators, the spacing between anchor towers must not exceed:
    - 10 km in regions where ice accretion thickness is up to 10 mm
    - 5 km in regions where ice accretion thickness is 15 mm or more

383. Anchor towers are used in the cases specified in Rules 400, 413, 423, 426, 431, 435, 438, and 445. Lighter anchor tower designs are installed at line turns and crossings with various objects, where intermediate towers do not ensure the required reliability under OHL operating conditions.

384. Reinforced concrete tower poles must have a factory marking indicating the pole code, and circular markings indicating the depth of pole embedment.

Rules for the Installation of Electrical Lines and Wiring

Annex 2

REQUIREMENTS FOR THE INSTALLATION OF ELECTRICAL LINES

Table 1. Wind Pressure Correction Coefficients at Heights Other Than 10 m Above Ground Level

Height Above Ground Level, m	Type of Area		
	A (no obstacles)	B (obstacles higher than 10 m and up to 25 m)	C (obstacles higher than 25 m)
<5	0,75	0,5	0,4
10	1,0	0,65	0,4
20	1,25	0,85	0,55
40	1,6	1,1	0,8
50	1,7	1,3	1,0

Height Above Ground Level, m	Type of Area		
	A (no obstacles)	B (obstacles higher than 10 m and up to 25 m)	C (obstacles higher than 25 m)
80	1,85	1,45	1,15
100	2,0	1,6	1,25
150	2,25	1,9	1,55
200	2,45	2,1	1,8

Table 2. Correction Coefficients for Iced Wall Thickness at Heights Other Than 10 m Above Ground Level

Height Above Ground, m	5	10	20	30	50	70	100
Coefficient	0,8	1,0	1,2	1,4	1,6	1,8	2,0

NOTE: For intermediate heights in Tables 1 and 2, correction coefficients are determined using linear interpolation.

Table 3. Correction Coefficients for Iced Wall Thickness for Conductors with Diameters Other Than 10 mm

Conductor or Cable Diameter, mm	5	10	20	30	50	70
Coefficient	1,1	1,0	0,9	0,8	0,7	0,6

Table 4. Minimum Diameter of Steel-Aluminum Conductors for Overhead Lines (OHL) Under Corona Discharge Conditions

OL Voltage, kV	Phase Conductor Diameter, mm	
	Non-bundled	Bundled
110	11,4	–
330	33,2	3 x 17,1 ir 2 x 21,6
400	–	3 x 24,5 ir 2 x 36,2

Table 5. Minimum Permissible Distances Between Conductors of Overhead Lines (OHL) with Suspension Insulators in Horizontal Arrangement

Voltage, kV	Minimum Distance Between Conductors, m, at Sag (m)						
	3	4	5	6	8	12	16
35	2,5	2,5	2,75	2,75	3,0	3,25	3,75
110	3,0	3,25	3,5	3,5	3,75	4,0	4,5
330	–	–	–	5,5	5,75	6,0	6,5
400	–	–	–	7,0	7,25	7,5	8,0

Table 6. Minimum Horizontal Displacement Between Conductors of Adjacent Levels on Intermediate Towers in Regions Where Conductor Galloping Occurs Once Every 5–10 Years

Voltage, kV	Vertical Distance, m	Horizontal Displacement Between Adjacent Conductors, m, at Sag (m)							
		4	5	6	8	10	12	14	16
35	2,5	0,70	0,70	1,0	1,60	2,0	2,30	2,50	2,60
	3,0	0,7	0,70	0,70	1,30	1,80	2,15	2,35	2,55
	3,5	0	0,70	0,70	1,0	1,70	2,10	2,30	2,50
	4,0	0	0,7	0,70	0,70	1,5	2,0	2,20	2,45
	4,5	0	0	0,7	0,70	1,1	1,80	2,10	2,40
	5,0				0,7	0,7	1,60	2,00	2,30
	5,5	0	0	0	0,70	0,70	1,00	1,90	2,25
	6,0	0	0	0	0	0,70	0,70	1,60	2,10
	6,5	0	0	0	0	0	0,70	1,10	1,90
	7,0	0	0	0	0	0	0,70	0,70	1,60

Table 7. Minimum Horizontal Displacement Between Conductors of Adjacent Levels on Intermediate Towers in Regions Where Conductor Galloping Occurs Once Every 5 Years

Voltage, kV	Vertical Distance, m	Horizontal Displacement Between Adjacent Conductors, m, at Sag (m)							
		4	5	6	8	10	12	14	16
35	3,0	0,70	1,25	1,55	2,05	2,35	2,65	2,95	3,20
	3,5	0	0,70	1,30	1,90	2,30	2,65	2,95	3,20
	4,0	0	0,70	0,70	1,70	2,20	2,60	2,90	3,20

Voltage, kV	Vertical Distance, m	Horizontal Displacement Between Adjacent Conductors, m, at Sag (m)							
		4	5	6	8	10	12	14	16
	4,5	0	0	0,70	1,30	2,05	2,50	2,85	3,15
	5,0	0	0	0	0,70	1,80	2,35	2,75	3,10
	5,5	0	0	0	0,70	1,40	2,20	2,65	3,05
	6,0	0	0	0	0	0,70	1,90	2,50	2,95
	6,5	0	0	0	0	0,70	1,40	2,30	2,85
	7,0	0	0	0	0	0	0,70	2,00	2,65

Table 8. Minimum Horizontal Displacement Between Conductors of Adjacent Levels on Anchor Towers

Voltage, kV	Minimum Displacement, m, at Iced Wall Thickness (mm)	
	5–10	15–20
35	0,5	0,7
110	0,7	1,2
220	1,5	2,0
330	2,0	2,5

Table 9. Minimum Horizontal Displacement Between Conductors and Ground Wires on Intermediate Towers of 400 kV Overhead Lines

Vertical Distance Between Conductors and Ground Wires, m	Minimum Displacement, m, at Sag (m)			
	10	12	14	16
9,0	2,0	3,5	4,0	4,0
10,0	2,0	3,0	4,0	4,0
11,0	2,0	2,0	3,0	3,5
12,0	2,0	2,0	2,5	3,0

Table 10. Minimum Horizontal Displacement Between Conductors and Ground Wires of Adjacent Levels on Intermediate Towers for 110–330 kV Overhead Lines

Voltage, kV	Minimum Horizontal Displacement, m, at Vertical Distance Between Conductors and Ground Wires (m)		
	3,0–4,5	5,0–9,5	≥10
110	1,5	1,2	-
220	2,5	2,0	1,5
330	-	3,0	2,5

<>

Table 14. Minimum Horizontal Distance Between Approaching Overhead Lines (OL)

OL Sections and Distances	Minimum Distance, m, at OL Voltage (kV)					
	Up to 10	35	110	220	330	400
In standard route sections between OHL axes		Height of the tallest Tower*				
In narrow route sections and near substations:	2,5	4	5	8	10	15
Between outermost non-deviated OHL conductors from deviated OHL conductors to other OHL towers	2	4	4	6	8	10

NOTE: *When 400 kV OHLs approach each other or lower-voltage OHLs, the minimum distance between these lines must be equal to the height of the tallest tower, but not less than 50 m.