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Working Party on General Safety Provisions (GRSG)  
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agenda item 1.)

PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 36  
(Public service vehicles)

Transmitted by the Expert from the Russian Federation

Note: The text reproduced below was prepared by the expert from the Russian Federation in order to incorporate into the Regulation technical provisions for trolleybuses (TRANS/WP.29/GRSG/55, para.16 and TRANS/WP.29/680, paras.56 and 64). It is a first draft, to which some additional provisions may later be added, in particular in the text of the Regulation.

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Note: This document is distributed to the Experts on General Safety Provisions only.

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Insert a new annex 8, to read :

"Annex 8

SAFETY PRESCRIPTIONS FOR TROLLEYBUSES

1. Power collection
  - 1.1. Electrical power from overhead wires is transmitted to trolleybus with power collectors. The power collector is comprised of a pole, a trolley electric current collector and a replaceable collector insert. Power collectors are hinged to trolley bases, and turning in horizontal and vertical directions.
  - 1.2. Poles shall be made of plastic or metal, covered with insulating material resistant to metal shocks. Insulation shall be repairable.
  - 1.3. Power collectors shall maintain adequate positive contact with the overhead trolley electric supply wires when the wires are located at a height of 4 to 6 metres above the ground and at trolleybus touring excursion deviation distance of 4.5 metres to each side with respect to the axis of the overhead wires.
  - 1.4. In case the pole dewires, trolley electric current collector shall not be raised higher than 7.2 metres and declined lower than 2.2 metres above the roadway.
  - 1.5. The free end of each trolley pole shall be attached by means of a rope to a retriever. In case the pole dewires, the retriever shall automatically, reliably, quickly, and firmly pull the pole down. The rope material shall not transfer contact network potential to the trolleybus body.
  - 1.6. The trolley electric current collector, if wrenched out of the pole, shall be kept connected to the pole and should not fall down on the roadway.
  - 1.7. Insulation resistance of the power collector shall be at least, megohm [ **MS** ]:

(i) the electric current collector to metal pole .....	5 <b>MS</b>
(ii) cable inserted into pole .....	5 <b>MS</b>
(iii) trolley bases to the body .....	10 <b>MS</b>
  - 1.8. Raising of the poles and maintaining adequate upward pressure to overhead wires shall be provided with an adjustable spring mechanism.
  - 1.9. In the driver's compartment there shall be remote control for power collectors at least for dewiring.

- 1.10. There shall be made certain arrangements at the body to provide access to the roof for the driver and service personnel to inspect equipment including trolley electric current collectors and replace, if necessary, carbon inserts in transit service conditions.
- 1.11. Electrical and electronic subsystems and components shall not directly emit (radiated or induced emissions), or indirectly conduct via the trolley wires (conducted emissions), any electromagnetic radiation that will interfere with radio and television transmission and reception, passenger-carried electronics, or on-board equipment. The trolleybus electrical and electronic operating and control systems shall not be susceptible to electromagnetic interference from external sources.
2. Traction and auxiliary equipment
  - 2.1. Electrical components energised by the trolley line voltage, including the traction equipment, the battery charger, auxiliary converters, and accessory equipment, shall be protected against overvoltage and overcurrent surges. All circuits and circuit branches shall be protected individually by automatic reset remote controlled circuit breakers or fuses. Breaker with a manual reset control may be installed in easy accessible areas. The breaker response time shall be 10 milliseconds maximum. Circuit breakers shall be grouped and installed at the source of the circuit or circuit branch. The circuit breakers shall interrupt the positive side of each circuit, and shall trip upon at overcurrent condition.
  - 2.2. In the event fuses are used, they shall be of the delayed-action current-limiting type, and easily accessible for replacement.
  - 2.3. Precautions shall be taken to minimise hazards to the driver or passengers arising from circuit breakers or fuses.
  - 2.4. Electrical schemes shall exclude any source of current circulation in an overcurrent transient point after the circuit interruption by a breaker or fuse.
  - 2.5. All electrical circuits and circuit branches shall be of dual wiring. Trolleybus body should not be used for current return grounding.
  - 2.6. A trolleybus should be as tolerant as possible to power system operational working range of 400 to 730 Volts direct current (DC).
  - 2.7. Electrical components energised by the trolley line voltage shall have two steps of insulation at least.

- 2.8. All relays, controllers, flashers, automatic resetting circuit breakers, and other electrical components shall be mounted in easily accessible apparatus junction boxes to the maximum extent possible. The boxes shall be sealed to prevent moisture from normal sources, from reaching the electrical components and shall prevent fire that may occur inside the box from propagating outside the box. The components and circuits in each box shall be identified, and their locations shall be recorded on a schematic drawing permanently glued to or printed on the inside of the box cover or door, and protected from moisture, water, oil, grease, dirt, and abrasion. The use of junction blocks or panels shall be minimised, and must be located in a shielded environment or protected area.
- 2.9. Electrical components shall be protected against moisture and dust inside the body, on insulated and conducting parts.
- 2.9.1. Ventilation system of the rotating electric machinery and apparatuses, rated for 600 V DC, shall be guarded against the entry of moisture, snow, dirt, dust and abrasives on current conducting parts.
- 2.10. At nominal climatic conditions for a dry and clean trolleybus, not operated before, insulation resistance of electrical circuits when all rotating machines and apparatuses are switched on shall not be less than, megohm [ MS ] :
- (i) body to electrical circuit rated to voltage of 600 V DC 5 MS
  - (ii) electrical circuits rated to voltage 600 V DC  
to electrical circuits rated to voltage 24 V DC 5 MS
  - (iii) body to electrical circuits rated to voltage of 24 V DC 1 MS
- 2.11. Wiring, cabling and apparatuses
- 2.11.1. Wiring and cabling must operate reliably and exhibit durability at ambient temperature range of minus 60 °C to plus 70 °C. They shall be protected against direct sunlight.
- 2.11.2. All high voltage DC wiring shall be of copper. The wire insulation shall be rated for 3,000 V DC and should not emit harmful substances when heated or burning.
- 2.11.3. Wires to be connected with moveable current collectors shall be separated with elastic tape, synthetic material or rubber tube.
- 2.11.4. Mounted wiring and cabling should not be tightened. Each wire or cable shall allow replacement of end terminals twice without pulling, stretching, or replacing the wire.

- 2.11.5. Wiring, cabling and terminals shall be resistant to:
- (a) simultaneous binding and torsion;
  - (b) relative humidity up to 98 per cent at the ambient temperature of 40 °C;
  - (c) temperature change from plus 70 °C to minus 50 °C in the period of one hour.
- 2.11.6. Wiring insulation should not propagate burning.
- Wiring insulation shall also be resistant to water, ozone, oil, abrasive action of dust, and fall out hoar-frost.
- 2.11.7. Wiring harness shall not contain wires of different voltages. Terminations of mixed voltage harness or bundle runs shall be separated by total enclosure in metallic chassis potential boxes or compartments.
- 2.11.8. Wiring shall pass in non-flammable rigid or flexible conduits.
- 2.11.9. Wiring tubes located under the floor shall be closed-end to exclude propagation of water and dust.
- 2.11.10. Underfloor wiring shall be limited to the extent practicable. Wiring and electrical equipment necessarily located under the trolleybus shall be sheathed from water and dust with non conductive rigid or flexible conduits.
- 2.11.11. Fastening and arrangement of wiring and cables shall exclude damage (fraying) of insulation. Grommets of elastomeric material shall be provided at points where wiring penetrates metal structure. Radius of bent pipe containing wiring shall be three external diameters of the pipe at minimum.
- 2.11.12. Location of wiring in apparatuses disconnecting electrical current shall exclude burning or damage of the wiring insulation by an electrical arc.
- 2.11.13. Precautions shall be taken to avoid damage of wiring and cables from heated resistors and other electrical components. In critical areas thermoresistant wires or cables shall be used.
- 2.11.14. Wiring holders, connectors, and other devices for mounting shall be made of inflammable or hardly flammable materials. Electrical components of the hardly flammable materials may be installed outside passenger compartment only.
- 2.11.15. At nominal mode, working temperature of connections should not be higher than 95 °C.

At overcurrent surge condition the temperature should not be higher than 300 °C.

- 2.11.16. The test voltage for electrical equipment with respect to the working voltage :

Working voltage	24 V	750 V DC;
Test voltage	600 V	3300 V DC.

- 2.12. Electrical machines, apparatuses, devices, wiring and cables installed into trolleybus shall withstand mechanical loading, applied to fixations, as follows :

- (i) sine vibration of 0.5 - 55 Hz frequency and 10 m/s<sup>2</sup> maximum amplitude;
- (ii) discreet shocks of 30 m/s<sup>2</sup>, peak shock acceleration lasting 2 - 20 milliseconds in the vertical direction.

3. Braking equipment

- 3.1. A trolleybus shall be equipped with independent brake systems as follows:

- (i) service brake system acting on all wheels;
- (ii) secondary electrodynamic brake system, working independently on presence of voltage in the contact network;
- (iii) parking brake system acting on driven wheels.

- 3.2. Service and secondary brakes shall be activated with the same pedal.

4. Electrical safety of passengers and service personnel.

- 4.1. At nominal climatic conditions for a dry and clean trolleybus, connected with both power collectors to wire of positive polarity, and not operated before, leakage current from the body shall not be higher than 0.25 milliamperes [ mA ] at voltage of 600 V DC.

- 4.2. At any operation conditions leakage current shall not be higher than 3 milliamperes [ mA ] at voltage of 600 V DC.

- 4.3. A trolleybus must be equipped with an onboard indicator, or another device, for permanent measurement of leakage current or protection of people at the appearance of leakage current.

- 4.4. If the leakage current is registered, the device shall initiate the disconnection of rapid main switch for 600 V DC, and switch on the remote control of the retriever.
- 4.5. Stanchions at doorway shall be made of insulated material or plated with mechanically durable insulation. Insulation resistance shall at least be 1.0 megohm [ MS ] on a contact square of 100 cm<sup>2</sup>.
- 4.6. The first steps shall be made of insulated material or plated with mechanically durable insulation. Insulation resistance shall be 1.0 megohm [ MS ] at a square of contact of 300 cm<sup>2</sup>.
- 4.7. Door panels shall be made of insulated material or insulated from the trolleybus body. Insulation resistance shall be 1.0 megohm [ MS ] at least at a contact square on the panel of 300 cm<sup>2</sup>.
- 4.8. Sidewall area adjacent to the door apertures shall be plated with insulation. The insulated area shall extend 500 millimetres wide each side of the door aperture and at least 2,000 millimetres high from the roadway. Insulation resistance shall not be less than 1.0 megohm [ MS ] at a square of contact of 200 cm<sup>2</sup>.
- 4.9. A trolleybus shall be equipped with the driver's door, separated from the passenger compartment.
- 4.10. For the service personnel the safety roof area, where electrical equipment is mounted, shall be covered with a rough insulating material.
- 4.11. When a trolleybus is stationary, pressing the brake pedal shall not cause voltage of 600 V DC in the electrical circuits.
- 5. The driver's compartment
  - 5.1. There should not be high voltage equipment in the driver's compartment.
  - 5.2. On the instrument panel there shall be installed gauges and indicators as follows:
    - 5.2.1. gauge indicating voltage of the contact network;
    - 5.2.2. audible indicator of disappearance voltage at power collectors;
    - 5.2.3. indicator of the main automatic switch state;
    - 5.2.4. indicator of power collectors position;

- 5.2.5.           voltmeter and ampermeter indicating voltage and charge/discharge  
                  current of the trolleybus low voltage batteries;
  - 5.2.6.           indicator of dangerous potential on the body or leakage current."
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