TECHNICAL SPECIFICATION
Class 4 (36 kV AC) Electrical Insulating Gloves

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Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED
পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড
(পশ্চিমবঙ্গ সরকারের একটি উদ্যোগ)

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1. Scope

This specification covers **Class 4** rubber insulating gloves (36 kV AC rating) for use by West Bengal State Electricity Transmission Company Limited (WBSETCL) in live-line work. The gloves shall meet **IEC 60903:2014** (Live Working – Electrical Insulating Gloves) requirements for dielectric protection and mechanical durability. All gloves supplied must be suitable for 36 kV AC (54 kV DC) service and shall include necessary over-gloves (leather protectors) for mechanical safety. The gloves shall provide protection against electrical shock, ozone, oils, acids, and cold as specified below, and be certified CE (double-triangle symbol) as live-working PPE.

2. Standards and Compliance

- **IEC 60903:2014** (Live Working – Electrical Insulating Gloves) – all requirements, testing, marking and documentation shall comply with this standard.
- **EN 60903:2003** (European adoption of IEC 60903).
- **CE Marking / EU PPE Regulation** – Gloves shall be Category III PPE with CE mark and double-triangle symbol (IEC 60417-5216) for live working.
- **ASTM D120** (for reference only) – equivalent tensile and dielectric requirements (optional certification).
- Applicable Indian safety regulations and company standards for live-line work.

3. Glove Class and Electrical Ratings

- **Class:** 4 (highest voltage class).
- **Maximum Service Voltage:** 36 000 V AC (phase-to-earth) under normal conditions. Equivalent DC rating is 54 000 V (DC).
- **Proof (Dielectric) Test Voltage:** Gloves shall withstand the routine AC test at *40 000 V AC* for the prescribed time without breakdown. (A 70 000 V DC proof test is also required for Class 4.)
- **Minimum Withstand Voltage:** Per IEC 60903, Class 4 gloves must not fail at a 50 000 V AC breakdown test.
- **Working Temperatures:** Standard gloves rated for use from –25 °C to +55 °C; Category C (extreme cold) gloves rated down to –40 °C if specified. Temperature guidance per IEC60903 Annex A.
- **Design Safety Margin:** Gloves shall be used only below these limits (WBSETCL shall select gloves of next higher class for any higher exposure).

4. Material and Construction

- **Material:** Natural rubber latex or equivalent high-dielectric elastomer. Gloves may be lined or unlined, manufactured by dip process. Material must be free of holes or defects and meet insulation and strength tests. External covering (if any) must be contrasting color to inner layer for damage visibility.
- **Color:** Bi-color design is required for high classes. Typical color coding: *inner natural (cream/beige), outer color by class*. For Class 4, many manufacturers use a red/orange outer layer with natural-colored liner (e.g. CATU CG-4: natural inside, red outside). This bi-color aids visual inspection for cuts. Single-color gloves (e.g. orange or black) are also acceptable if clearly marked.
- **Thickness:** As per IEC60903 Table 3, maximum flat-surface thickness of Class 4 gloves is **3.60 mm** (standard) or **4.20 mm** if composite (mechanically enhanced). Allowable additional 0.6 mm for long gloves or for special categories (A, H, Z, R). Actual thickness shall be sufficient to pass dielectric tests.
- **Length:** Standard lengths are **410 mm (16")** and **460 mm (18")** cuffs (measured from palm crease to cuff edge). Long gloves (800 mm) may be supplied upon request for shoulder protection. Gloves shall have a comfortable cuff (rolled or straight) for easy donning and handling.
- **Workmanship:** Smooth inner and outer surfaces free of harmful defects (pinholes, cuts, embedded debris). Mold marks or cosmetic blemishes are acceptable only if they do not protrude or tear when stretched (IEC 60903 guidelines on "non-harmful irregularities"). Each glove shall have a clean finish with well-formed fingers and an even rolled cuff.

5. Mechanical Strength and Durability

Gloves shall meet these minimum mechanical criteria (per IEC 60903 and ASTM D120):

- **Tensile Strength:** ≥ 16 MPa (average).
- **Elongation at Break:** ≥ 600% (average).
- **Puncture Resistance:** ≥ 18 N/mm (minimum).
- **Tension Set:** ≤ 15% (after 5 min at 50% elongation).

These ensure the glove can endure handling stresses. (Manufacturers typically test sample pieces or whole gloves in tension per ISO/DIN methods.) All gloves shall be subject to factory proof testing and inspection; any gloves failing to meet mechanical or dielectric criteria shall be rejected.

6. Thermal Requirements

Gloves must resist cold-temperature cracking and flame:

- **Cold Resistance:** After 1 h at–25 °C, gloves shall be flexible. No cracks, fissures or tears shall appear upon bending/folding the finger and cuff. After cold conditioning, each glove must still pass the specified dielectric proof test. (Category C gloves provide additional cold resistance.)
- **Flame Resistance:** A flame is applied to a glove finger tip for 10 s. The material shall self-extinguish and the flame must not propagate beyond 55 mm from the tip after 55 s. The glove material shall not drip or sustain burning. All gloves must pass this flame test per IEC 60903.

Failure in thermal tests disqualifies the glove batch. Any glove with visible damage after these tests shall be rejected.

7. Ozone and Chemical Resistance

Gloves shall be resistant to atmospheric ozone and common contaminants:

- **Ozone Resistance:** Class 4 gloves must meet IEC ozone test (exposure in 100 ppm ozone at 40 °C for 48 h) without cracking. Glove samples should comply with Category **Z** requirements. In practice, *category RC* gloves (resistant to acid, oil, ozone, low temperature) are recommended for HV use.
- **Oil and Acid Resistance:** At minimum, gloves should resist attack by insulating oils and acids encountered in the electrical environment. Category **H** (oil) and **A** (acid) ratings are optional; if claimed, tests per IEC 60903 must be passed. Category R combines A+H+Z.
- **Ozone (Category Z)** and **R (A+H+Z)** markings must be applied if tested for these properties. It is strongly recommended that Class 4 gloves be at least ozone-resistant (Cat. Z) to avoid embrittlement near live conductor corona. Acid and oil resistance are beneficial but not mandatory unless specified.

8. Testing Requirements

The supplier shall perform full testing per IEC 60903:2014. Key tests include:

- **Electrical Type Tests:** Dielectric tests on representative samples (proof and withstand at required voltages), partial discharge, and insulation breakdown tests per IEC 60903 (see Section 3 above and IEC table values).
- **Routine Tests:** Every glove shall be **100% AC leak-tested** at the proof voltage (40 kV) before shipment. Each glove must pass without corona or breakdown. (Routine DC test at 70 kV may be applied if specified)
- **Mechanical Tests:** Tensile, elongation, puncture tests on sample pieces as per standard (see Section 5 above).

- **Thermal and Aging:** Cold bend and flame tests on gloves (see Section 6). Accelerated aging in oven (70 °C, 168 h) may be done to verify post-aging tensile ≥80% of original (optional). Gloves must still pass dielectric test after aging.
- **Ozone and Chemical Tests:** If claiming categories Z, H, A, perform IEC ozone, oil, and acid resistance tests respectively.

All tests must be documented. The manufacturer shall have an ISO 17025–accredited lab or equivalent for testing. If batch sample-testing is used (per IEC sampling plan), the frequency shall meet standard. Records of each test shall be maintained.

9. Marking and Identification

Each glove shall be **permanently marked** (moulded or printed) with at least: manufacturer name/logo, **glove class (4)**, standard reference (e.g. "IEC 60903" or "EN 60903"), **rated voltage** (36 kV AC), glove **size** (according to palm circumference), and **year/month of manufacture**. The double-triangle symbol (live working) and CE mark (PPE category III) must appear. Category suffix letters (A, H, Z, R, C) shall be added after the class if tested (e.g. "4/Z" for ozone-resistant).

In addition, **traceability markings** are required: each glove shall bear a unique batch/serial number and the date of last electrical proof test. For example, glove IDs ("Lot No.") or QR/flash codes linking to test records are recommended. Any glove failing its test shall have its ID invalidated. The manufacturer should offer a marking plate or card for each pair indicating class, batch test date, expiry/retest date, and usage instructions.

All markings shall be durable and clear. Inks or labels susceptible to wear are unacceptable. The marking durability test (IEC 60903 §5.3.2) shall be satisfied.

10. Dimensions and Sizing

- **Lengths:** Supply gloves in lengths of 410 mm (minimum) and 460 mm (longer cuffs). (Long gloves of 800 mm are optional for special use.) The tolerance on length shall be ±10 mm.
- **Palm Circumference (Size):** Offer a range of sizes to fit palm circumferences approx. 230–300 mm (US sizes 7–12). Half sizes (e.g. 9.5) are acceptable if specified. The glove width should permit comfortable inflation during leak test (no stress in relaxed state). Size designations should follow industry (e.g. "Size 10" for 260–270 mm palm circumference).
- **Thickness:** See Section 4. The rolled cuff adds approx. 0.6 mm.
- **Tolerance:** Dimensional tolerances of size and length per IEC 60903 shall be maintained (e.g. ±20 mm on length of long gloves). Consistency in dimensions between pairs is expected for proper fit.

Size and length options should be clearly indicated in the bid. The default length shall be 410 mm unless otherwise specified. Gloves must fit the wearer's palm without excessive looseness; as guidance, palm measurement and glove sizing charts should be provided (see sizing instructions in references).

11. Accessory Equipment (Leather Protectors)

Standard Class 4 insulating gloves **do not provide mechanical protection** against cuts or punctures. Therefore, **leather protective overgloves** shall be furnished for use with each insulating glove. Leather protectors (ANSI/ASTM Type 1 or Type 2) covering the fingers and entire palm and cuff shall be worn over the rubber gloves during live work. The specification may call for black split-leather mittens or gloves (without rubber content) sized to fit over the insulating gloves. Overgloves shall comply with IEC 60903 annex guidelines (distance from rubber cuff to top of protector) to avoid puncture to the insulating layer. (Alternatively, composite insulating gloves with built-in mechanical layer may be offered; these shall be clearly identified and tested per IEC 60903 composite clause.)

12. Documentation and Certification

Supplier must furnish, in English, the following with each delivery:

- **Manufacturer's Test Certificate:** Signed document showing compliance with IEC 60903 (or EN 60903) and CE (PPE Directive) for the model supplied. Include test data (proof voltage, mechanical tests, aging, etc.) from type tests.
- **Batch Inspection Reports:** For each shipment lot, provide a routine test report listing glove IDs, date of test, and results (leakage current or pass/fail at proof voltage). (A table or certificate form is acceptable.) Ensure traceability to glove serial numbers.
- **Declaration of Conformity:** Formal CE declaration or equivalent stating conformity with IEC60903:2014 and EU PPE Regulations, with standard references.
- **User Manual:** Guidance on inspection (visual and inflation checks), cleaning (no solvents, mild soap only), storage (temperature, UV avoidance) and retesting interval (maximum 6 months per IEC 60903 annex). Include glove size chart and usage precautions (latex allergy warning).
- **Warranty:** Conformance warranty (e.g. 12 months from receipt) covering manufacturing defects.
- **Maintenance Records:** Where applicable, initial date of factory test and next due test date field shall be included on accompanying documentation for WBSETCL record.

All documentation shall be neatly bound or foldered. Any certificates must bear authorized signatory, official letterhead, and date.

13. Inspection and Acceptance

WBSETCL reserves the right to inspect and test the gloves on receipt. The supplier shall coordinate with WBSETCL's quality personnel for any factory acceptance tests (FAT) or witnessing of dielectric tests if required. Any gloves failing to meet the above specifications will be rejected and replaced at supplier's expense. The bidder shall specify lead time, shipping conditions (preferably shipments protected from heat/light), and provide sample pairs for evaluation if requested.

Notes: WBSETCL may request training or technical clarification. All technical terms (AC proof test, IEC codes, etc.) follow international usage. The above parameters are mandatory; deviations must be clearly identified and justified in the bid, but acceptance is unlikely unless substantially equivalent and approved by WBSETCL.

References: IEC 60903:2014 standard; CATU CG-4 datasheet; NOVAX/JM Test glove data; Ungloves (EN60903 guide); professional safety equipment catalogues. These informed the above requirements.