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SELECTION GUIDE 9 min read Updated June 2026

IEC 60815 Pollution Severity and Creepage Distance: A Specification Guide for High-Voltage Insulators

How to translate site pollution measurements into defensible insulator creepage specifications, with the SPS framework, USCD tables, and profile constraints.

TECHNICAL REFERENCE

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IEC 60815 is the international framework for selecting insulators in polluted environments. It links mea phase-to-ground), so an EPC team can defend its insulator length and profile against an audit rather t measurement, classification, and the USCD concept; **Part 2** applies the framework to ceramic and gla hydrophobicity transfer; **Part 4** addresses HVDC; **Part 5** covers polymer DC. Pollution is classified into *e (very heavy)* — measured by ESDD (equivalent salt deposit density) and NSDD (non-soluble deposi used 31 mm/kV because that's what the last project used" is not a defensible specification — and on flashover.

1. Why Creepage Distance Matters More Than Rated Voltage

Pollution flashover does not occur because the rated voltage is exceeded. It occurs because a thin la under leakage current, partial arcs ignite across the dry bands, and — if the leakage path is too short distance, with the right profile, so a continuous arc cannot establish itself.

This is why two insulators with the same arcing distance and the same rated voltage can have very di one of the most common procurement errors in coastal, desert, and industrial-zone projects worldwic

2. Site Pollution Severity (SPS): The Five Classes

IEC 60815-1 defines five SPS classes based on measured ESDD and NSDD, taken over at least one ye

SPS CLASS	DESCRIPTOR	ESDD (MG/CM²)	NSDD (MG/CM²)	TY
a	Very light	≤ 0.014	≤ 0.06	Inl
b	Light	0.014 – 0.04	0.06 – 0.2	Inl
c	Medium	0.04 – 0.11	0.2 – 0.6	Su
d	Heavy	0.11 – 0.30	0.6 – 1.6	He
e	Very heavy	> 0.30	> 1.6	Dir

Two conditions must both be satisfied to assign an SPS class: ESDD *and* NSDD must each fall within projects within 3 km of the shoreline often qualify as *d* or *e*; pure inland desert sites are typically *c* to

3. USCD Recommendations by SPS Class

The unified specific creepage distance (USCD) is defined per kilovolt of **phase-to-ground** AC voltage recommends:

SPS CLASS	USCD (MM/KV PHASE-TO-GROUND)
a	22.0
b	27.8
c	34.7
d	43.3
e	53.7

These values apply to ceramic and glass insulators with reference profiles. Composite insulators may documented (see §5). For DC systems the values are higher and live in IEC 60815-4 / -5; do not apply

Worked example — 132 kV system, coastal MENA at SPS class *d*:

— Phase-to-ground voltage: 132 / √3 ≈ 76.2 kV

— Required creepage = 76.2 × 43.3 ≈ 3,300 mm

— A 132 kV station post specified at 2,500 mm of creepage will flashover under monsoon-condensati

4. Profile Factor: Why Total Creepage Alone Is Not Enough

USCD recommends a total creepage distance, but the *shape* of that creepage matters. IEC 60815-1 de **profile factor** that captures how alternating shed sizes affect leakage path bridging.

Practical rules:

— **CF ≤ 4** is generally acceptable. CF > 4 risks under-rib bridging where adjacent sheds short out unc

— **Alternating shed (large/small) profiles** outperform uniform sheds in heavy pollution. Most modern

— **Shed angle ≥ 5°** minimum on top surface to allow rain washing. Flat-top sheds in industrial zones b

— **Shed-to-shed spacing ≥ 30 mm** in heavy pollution to avoid arc-bridging.

A specification that names only the total creepage in mm and ignores profile geometry leaves room fo service.

5. Ceramic vs Composite: How IEC 60815-2 and 60815-3 Diverge

IEC 60815-2 (ceramic and glass) treats USCD as a fixed geometric requirement — the surface is perm recognizes that silicone rubber housings exhibit *hydrophobicity* — water beads up rather than spread

The Part 3 framework allows reduction of the USCD requirement **only** when the housing material's hy equivalent). Typical reductions are in the order of 15–30 % for well-characterized HTV silicone, but su

Practical rule for buyers: in SPS class *d* or *e* environments, **do not accept hydrophobicity reduction w** catalog or a generic claim about silicone. The hydrophobicity recovers only if pollution is washed off;

6. How to Measure or Estimate SPS for Your Site

Proper SPS assignment requires monitoring. Two paths:

1. **Direct measurement (preferred)** — Install reference insulators at the proposed substation site for depending on contamination rate. Use the maximum measured values, not the average, to assign
2. **Site survey + analogue method** — Where direct measurement is impractical (greenfield project, ti wind, dust fall, historical flashover records on nearby lines. IEC 60815-1 Annex E provides the des

commissioning if any flashover occurs.

For MENA projects with no measurement data, conservative practice is: SPS *d* for any site within 5 km proximity; SPS *e* reserved for direct shoreline or downwind of heavy industrial fallout. [INFERRED — engine

7. Specification Checklist for EPC Procurement

A defensible IEC 60815 specification states all of the following, not just the total creepage:

— **SPS class** (a / b / c / d / e), with the basis (measured ESDD/NSDD or analogue method)

— **Reference part of the standard** (60815-2 for ceramic/glass, 60815-3 for composite, 60815-4/5 for

— **Required USCD** (mm/kV phase-to-ground), explicitly stated, not derived by the supplier

— **Total creepage distance** (mm), calculated from USCD × phase-to-ground voltage

— **Profile constraints**: maximum CF (typically ≤ 4), minimum shed angle, alternating shed pattern if he

— **Hydrophobicity allowance**: state explicitly whether reduction is permitted, and on what test eviden

— **Test evidence required**: type test reports per the relevant IEC product standard, plus pollution test

If the bid book states only "creepage 31 mm/kV", suppliers will optimize against that single number an Specify all seven items above, and the technical comparison becomes auditable.

Content produced from heritage manufacturing knowledge of Zibo's insulator production cluster, incl documentation maintained continuously since 1998.

IN THIS ARTICLE

Definition 1. Why creepage matters 2. SPS classes (a–e) 3. USCD recommendations 4. Profile fact

FREQUENTLY ASKED QUESTIONS

Frequently Asked Questions

Is USCD measured against phase-to-phase or phase-to-ground voltage? +

Can I use the IEC 60815 USCD values for HVDC projects? +

How much hydrophobicity reduction can a composite supplier claim under IEC 60815-3? +

Our project is greenfield with no pollution measurement — what SPS class do we assume? +

Why does my supplier's catalog list creepage in inches and the IEC standard in mm/kV? +

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COMPARISON

Porcelain vs Composite Insulators

Material trade-offs, pollution performance, mechanical strength, and life-cycle cost across porcelain and silicone-housed composite designs.

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