

INSTALLATION INSTRUCTIONS

KITRIX®

Flange Isolation Gasket Kit

1. Scope and references

This procedure covers installation, tightening and electrical acceptance of flange isolation gasket kits (FIGK) used to electrically isolate cathodically protected pipework. A kit is accepted only when it is both leak-tight and electrically isolating; mechanical completion alone is not acceptance.

Applies to: raised-face (RF), flat-face (FF) and ring-type joint (RTJ) flanges to ASME B16.5, ASME B16.47 and EN 1092-1, kit types E, F and D (Section 2).

Where the project specification, the flange owner's procedure or the kit datasheet is stricter, the stricter requirement governs.

Document	Used for
ASME PCC-1 (current edition)	Flange face condition, alignment, bolt lubrication, tightening passes, assembler qualification
AMPP (NACE) SP0286	Electrical isolation of cathodically protected pipelines; isolation testing
ISO 15589-1 / ISO 15589-2	Cathodic protection of onshore / offshore pipelines (isolation joint requirements)
ASME B16.5, B16.47, B16.20	Flange dimensions, facing finish, ring-joint grooves
EN 1092-1, EN 1591-1	EN flanges; bolt-load calculation for EN joints
ASTM A193 B7 / A320 L7 / A194 2H, ASTM F436	Stud, nut and steel washer material

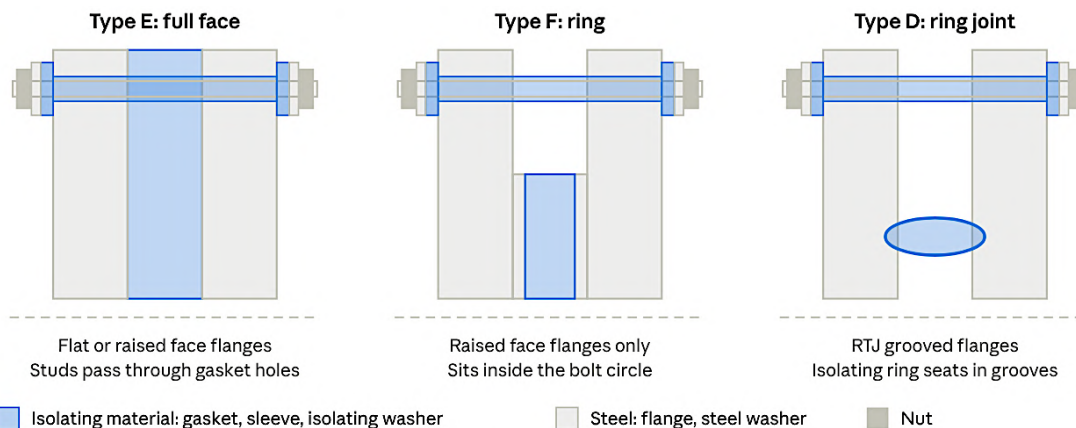
2. Kit components, gasket types and limits

Confirm the kit type, materials and temperature/pressure rating against the line data sheet before installation; a kit used outside its material limits will lose either seal or isolation.

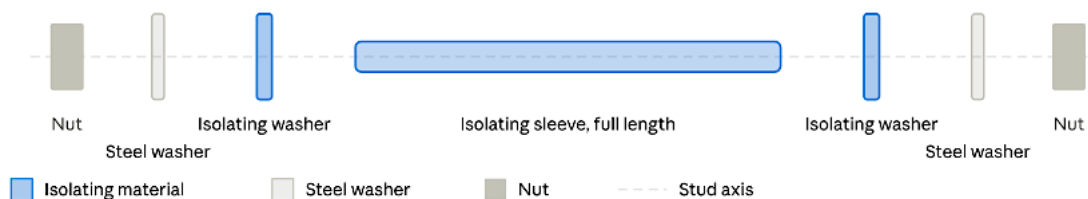
Gasket type	Flange facing	Geometry	Location method
Type E	Raised face or flat face	Full face, OD = flange OD, with bolt holes	Studs pass through the gasket holes
Type F	Raised face	Ring, OD fits inside the bolt circle	Rests on the lower studs / sleeves
Type D	Ring-type joint (RTJ)	Oval or octagonal isolating ring	Seats in the ring groove

Gasket type is set by the flange facing:

Half-section above the pipe bore (dashed line); one stud shown at the bolt circle



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Per bolt position, a kit contains: one full-length isolating sleeve, two isolating washers and two steel washers (double-washer kit). A single-washer kit has one isolating washer and one steel washer on one side only; the sleeve is still full length. Double-washer kits are preferred because one damaged washer does not short the joint.

Component	Common materials	Typical max. service temperature
Gasket retainer	Phenolic; neoprene-faced phenolic; G10 / G11 glass-reinforced epoxy	Phenolic ~107 °C; neoprene-faced ~93 °C; G10 ~150 °C; G11 ~200 °C
Sealing element (G10/G11 retainers)	Nitrile or FKM (Viton) O-ring; PTFE spring-energized seal	Nitrile ~120 °C; FKM ~200 °C; PTFE seal limited by retainer
Sleeve	Polyethylene; polyester (Mylar); G10; Nomex	PE ~80 °C; Mylar ~150 °C; G10 ~150 °C
Isolating washer	Phenolic; G10 / G11	As retainer
Steel washer	Zinc-plated carbon steel, ASTM F436 hardened	Not limiting

Neoprene-faced phenolic is a low-pressure, low-temperature, low-cost option. For hydrocarbons, high pressure (Class 600 and above), sour service or temperatures above ~90 °C, specify a G10/G11 retainer with an O-ring or PTFE seal.

3. Safety and preconditions

Work starts only under an approved permit with the line isolated, depressurized, drained, purged and verified gas-free.

- Apply lock-out/tag-out to all energy sources, including the cathodic protection (CP) system: switch off or disconnect the transformer-rectifier or galvanic anode bonds feeding the section.
- Complete all welding, cutting and grinding on both sides of the joint before the kit is installed. Never route welding return current through an installed isolation joint; it can arc across and carbonize the isolating components.
- In hazardous areas, confirm whether the joint requires a surge protection device or spark gap across it (per project CP design); install only after isolation testing.
- Personnel: bolting by assemblers trained to ASME PCC-1 (Appendix A) or equivalent; electrical testing by a competent CP technician.
- Tools: calibrated torque wrench or hydraulic torque tool (calibration certificate in date, typically ≤12 months, accuracy ±4 %); insulation resistance tester (500 V and 1000 V DC); drift pins; feeler gauges; straight edge; clean lint-free cloths and solvent.

4. Receipt, storage and handling

Isolating components are damaged more often in handling than in service; keep them boxed, flat, clean and dry until the moment of installation.

1. On receipt, check the kit label against the purchase order: nominal size, pressure class, flange standard, gasket type (E/F/D), retainer and seal material, sleeve material, washer configuration (single/double) and quantity of bolt sets.
2. Inspect every component: no cracks, delamination, chipped edges, warped or bent gaskets, cut or twisted O-rings, or split sleeves. Reject damaged parts; do not repair.
3. Store indoors in the original carton, lying flat, away from sunlight, heat sources, ozone (welding sets, electric motors), solvents and hydrocarbons. Do not stack heavy items on gaskets.
4. Phenolic components absorb moisture and lose insulation resistance when wet; if exposed to water, dry and re-test them (Section 6) before use.
5. Lift gaskets by both hands at the edges. Do not bend, roll, hang on a nail or slide across rough surfaces.
6. Keep sealing faces free of grease, anti-seize, metal filings and grit.

5. Pre-installation mechanical checks

Do not start assembly until every check below passes; an isolation kit tolerates less misalignment than a conventional gasket because sleeves and washers crack under side load.

5.1 Flange faces

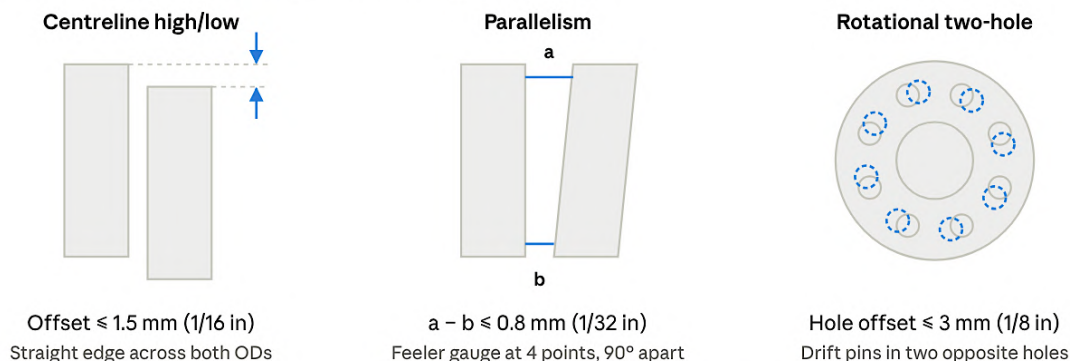
1. Remove old gasket residue with non-metallic or brass tools only; no grinding discs on sealing faces.
2. Clean faces with a lint-free cloth and a residue-free solvent; faces must be dry.
3. Assess scratches, pits and dents against ASME PCC-1 Appendix D (tables D-3-1 and D-3-2). Radial scratches across the seal area are the critical defect for O-ring and PTFE-seal kits.
4. Surface finish: 3.2–6.3 μm Ra (125–250 μin) for raised and flat faces, unless the kit datasheet states otherwise. O-ring seal kits seal best at the smoother end of this range.
5. Out-of-tolerance faces are re-machined within the flange standard's dimensional limits, or the flange is replaced.

5.2 Alignment (ASME PCC-1, Appendix E)

Check	Limit	How measured
Centerline high/low (offset)	$\leq 1.5 \text{ mm}$ (1/16 in)	Straight edge across flange ODs at 4 points
Parallelism (max. gap – min. gap)	$\leq 0.8 \text{ mm}$ (1/32 in)	Feeler gauge at 4 points, 90° apart
Rotational two-hole	$\leq 3 \text{ mm}$ (1/8 in)	Drift pins in two opposite holes
Face-to-face gap	Gasket thickness + $\leq 3 \text{ mm}$, uniform	Feeler gauge / rule

Three alignment checks must pass before any stud is tightened

ASME PCC-1 Appendix E limits; misalignment drawn exaggerated for clarity



Final test: every isolating sleeve slides into every bolt hole by hand

The joint must close and align without force: under hand pressure or a very light bolt load (PCC-1 guidance: no more than about 10 % of target bolt load). Never use the studs, chain blocks or jacks against the kit to pull flanges together. Correct misalignment in the piping supports.

Final practical check: all isolating sleeves must slide into all bolt holes by hand. If any sleeve binds, alignment is not acceptable.

5.3 Stud length

Isolation kits add two isolating washers and two steel washers per stud (double-washer kit), typically 6–12 mm more than a conventional joint. Order studs to: $2 \times \text{flange thickness} + \text{gasket thickness} + 2 \times (\text{isolating washer} + \text{steel washer}) + 2 \times \text{nut height} + 2 \times \text{thread pitches}$ minimum projection each end. After final tightening, the stud must project at least flush with each nut face, preferably 2–3 threads.

5.4 Sleeve length

Dry-fit one bolt set. The sleeve must pass completely through both flanges and the gasket and end inside the bore of each isolating washer. It must not stop short at a flange face (exposed stud-to-flange path) and must not reach the steel washer (sleeve crushed under bolt load). Reject kits that fail this check.

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5.5 Gasket fit

- **Type F:** gasket OD sits inside the bolt circle, and ID is not smaller than the pipe bore.
- **Type E:** gasket bolt holes match the flange drilling (standard, class and bolt count).
- **Type D:** ring size matches the groove number per ASME B16.20.

6. Pre-installation electrical checks

Record baselines before assembly so that the post-installation results in Section 9 can be judged.

1. Confirm all isolating components are dry and free of conductive contamination (metal filings, carbon, graphite or copper anti-seize, water, mud).
2. Optional sample test (recommended for phenolic components and for kits stored >12 months): test a sample of sleeves and washers between two clean metal plates at 500 V DC; reject any component below 100 MΩ.
3. Where the pipeline has existing CP or is already buried on one side, record the pipe-to-soil potential (vs Cu/CuSO₄ reference) on each side of the future joint. These readings are the reference for the potential test in Section 9.
4. Confirm both pipe sections are free of temporary earth straps, welding earth clamps and instrument cables that would bridge the joint.

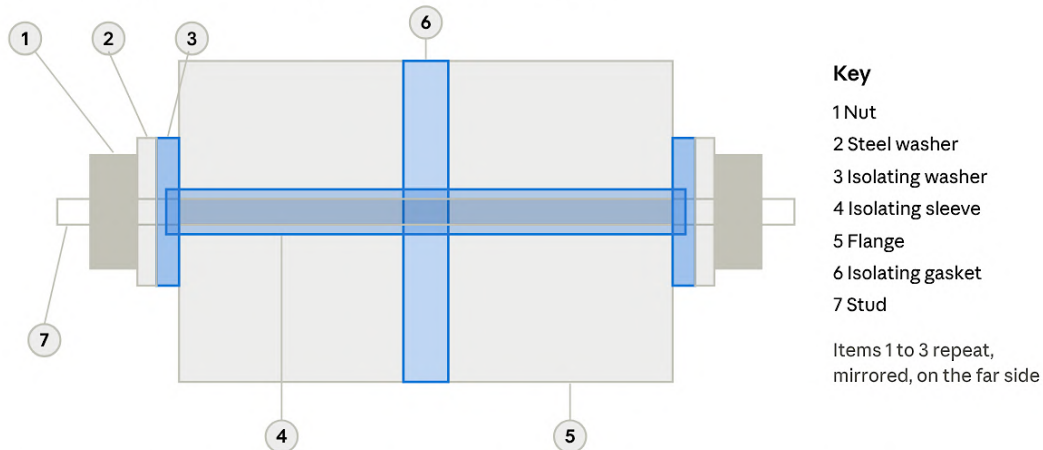
7. Assembly procedure

Stack order on every stud, from one end to the other:

Nut → steel washer → isolating washer → flange → (sleeve through flange, gasket, flange) → isolating washer → steel washer → nut.

The steel washer always sits between the nut and the isolating washer, so the rotating nut never bears on the isolating washer.

Every stud is wrapped in isolating material from nut to nut



The steel washer always sits between nut and isolating washer, so the turning nut never bears on isolating material.

The sleeve ends inside both isolating washers: never short of the flange face, never touching the steel washer.

1. Lay out one complete bolt set per bolt hole: stud, two nuts, sleeve, isolating washers, steel washers.
2. Lubricate: apply the lubricant specified in the torque table (its nut factor sets the torque) to the stud threads over the nut engagement length and to the nut face that bears on the steel washer. Keep lubricant off sleeves, isolating washers and gasket faces; wipe excess. Conductive anti-seize (copper, nickel, graphite) on an isolating component can short the joint.
3. Insert two tapered drift pins, driven in opposite directions, into two diametrically opposite bolt holes to set the bolt-hole pattern.
4. Pre-assemble each stud: run one nut on so that at least two full threads project beyond it; slide on a steel washer, an isolating washer and the sleeve.
5. Install the gasket according to type:
 - a. **Type F:** insert pre-assembled studs with sleeves into the lower half of the bolt pattern. Lower the gasket between the faces so it rests on the sleeves, then center it on the raised face.

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- b. **Type E:** hold the gasket between the faces and insert at least two pre-assembled studs through the lower flange holes and the gasket holes to carry it.
- c. **Type D:** seat the isolating ring in the groove of the lower flange; confirm it sits fully in the groove before closing the joint.
6. Insert the remaining studs with sleeves. On the opposite end of each stud, fit an isolating washer, a steel washer and a nut; tighten by hand only.
7. Check before tightening:
8. Gasket centered; on Type F the ring does not overlap the bore or bolt holes.
9. Every sleeve is fully inside its hole and ends inside both isolating washers (Section 5.4).
10. Every isolating washer sits flat on the flange nut seat, not on the hub fillet or overhanging the flange edge.
11. Flange gap uniform within 0.8 mm at four points.
12. Proceed to tightening (Section 8). The drift pins are removed during pass 1.

8. Bolt tightening

Tighten in four passes plus a check pass (ASME PCC-1 legacy method) to the kit manufacturer's target torque; never use a generic flange torque chart written for spiral-wound or metal gaskets, because it can crush phenolic retainers and isolating washers.

8.1 Target torque

Take the final (100 %) torque from the kit manufacturer's torque table for the exact kit type, retainer and seal material, flange standard, size and class, stud grade and lubricant. If a different lubricant must be used, recalculate:

$$T = K \times d \times \sigma_b \times A_s \div 1000$$

T = torque (N·m); **K** = nut factor of the lubricant actually used (typically 0.12–0.20); **d** = nominal stud diameter (m); **F** = target bolt load (N); **σ_b** = target bolt stress set by the manufacturer for the kit (MPa); **A_s** = stud tensile stress area (mm², per ASME B1.1 / ISO 898-1).

Target bolt stress for an isolation kit must satisfy three limits at once: above the gasket's minimum seating stress at design pressure, below the crush limit of the retainer and isolating washers, and below the stud's allowable stress.

8.2 Tightening passes

Pass	Torque (% of target)	Pattern	Action
0	Hand tight, max. 20 %	Cross	Seat all nuts evenly; check gap uniform
1	20–30 %	Cross	First two diametrically opposite studs; then replace drift pins with bolt sets; then all studs. Check gap at 4 points
2	50–70 %	Cross	All studs. Check gap at 4 points; correct before continuing
3	100 %	Cross	All studs
4	100 %	Rotational (clockwise, stud to stud)	Repeat until no nut rotates further
Check	100 %	Rotational	At least 4 h after pass 4, before hydrotesting; non-metallic retainers relax

If the flange faces do not touch the gasket evenly after pass 1, the gap was too large: stop, loosen, and correct alignment.

8.3 Cross-pattern sequences

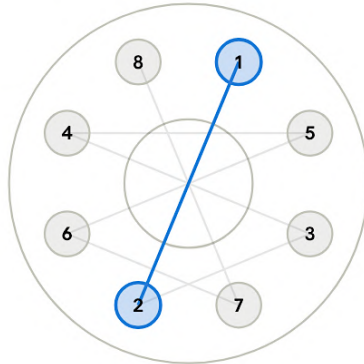
Bolt positions are numbered 1, 2, 3... clockwise around the flange. Tighten in the order below:

Bolts	Tightening order (position numbers)
4	1-3-2-4
8	1-5-3-7-2-6-4-8
12	1-7-4-10-2-8-5-11-3-9-6-12
16	1-9-5-13-3-11-7-15-2-10-6-14-4-12-8-16
20	1-11-6-16-3-13-8-18-5-15-10-20-2-12-7-17-4-14-9-19
24	1-13-7-19-4-16-10-22-2-14-8-20-5-17-11-23-3-15-9-21-6-18-12-24

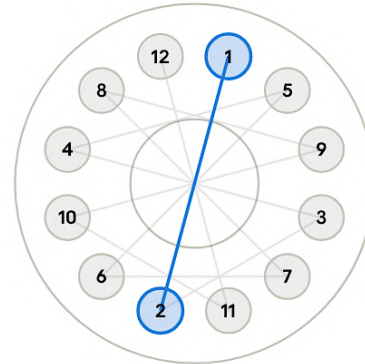
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Tighten across the flange, never around it, until the final rotational pass

Number in each hole = tightening order for passes 1 to 3; first diagonal pair highlighted



8 bolts



12 bolts

Pass 4 and the check pass: go round clockwise, stud to stud, at 100 % torque

For more than 24 bolts, use PCC-1 bolt grouping (Appendix J) or the manufacturer's sequence.

8.4 Tool rules

- Calibrated torque wrench or hydraulic torque wrench; apply torque smoothly to the nut, not to the stud end.
- Use a backing wrench on the opposite nut; the steel washer prevents the isolating washer from turning.
- Impact wrenches and hammer-wrenching are prohibited: shock loads crack isolating washers and sleeves.
- Hydraulic bolt tensioning only with the kit manufacturer's written approval: the tensioner bridge and load transfer can overload isolating washers, and studs need extra length.



9. Post-installation electrical verification

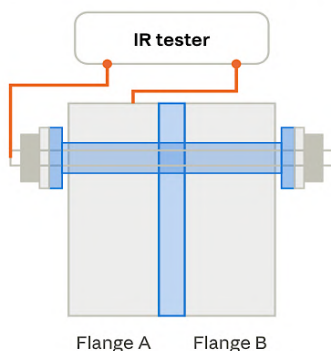
The joint is accepted only after it passes the electrical tests below; test after the check pass and again after hydrotesting and draining.

9.1 Insulation resistance (dry, line empty, CP off)

Test	Instrument	Valid when	Purpose
Each stud to flange A, and each stud to flange B	Insulation resistance tester, 500 V DC (1000 V DC if specified and within component rating)	Always	Proves every sleeve and washer set isolates; locates a defective stud
Flange A to flange B	Same, 500/1000 V DC	Only if the two pipe sections have no other electrical path (no common earth, support, bond or conductive fluid)	Proves the joint as a whole isolates

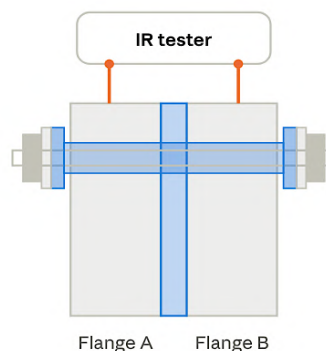
Test every stud first; flange to flange only when no parallel path exists

Insulation resistance tester, 500 V DC (1000 V DC if specified); line empty and dry, CP off



Test 1: each stud to flange A, then to flange B

Locates a cracked sleeve or washer on a single stud



Test 2: flange A to flange B

Invalid if earth, supports or product bridge the joint

Typical minimum, new dry joint: 10 MΩ per stud, 2 MΩ flange to flange. The project CP specification governs.

Single-washer kits: test each stud only to the flange on the isolating-washer side; the stud is in contact with the other flange by design. Acceptance values are set by the project CP specification. Where none is given, a commonly specified minimum for a new, dry joint is 10 MΩ per stud and 2 MΩ flange to flange; record actual readings, not "pass".

9.2 Installed or buried joints, or lines with other earth paths

A flange-to-flange resistance reading is not valid here, because parallel paths through soil, supports or product give a false low reading. Use one of these instead:

1. Radio-frequency isolation tester across the flanges (unaffected by most parallel DC paths).
2. Potential method (AMPP SP0286): with CP energized, measure pipe-to-soil potential on each side. Interrupt the CP source; the protected side shifts, the isolated side does not. Equal potentials that shift together indicate a shorted joint.
3. Current method: measure CP current flowing in the pipe on the isolated side; isolation is effective when no CP current crosses the joint.

9.3 Failure response

If any stud reads low, test studs individually to locate the fault, loosen the joint in reverse cross order, replace the damaged sleeve or washers (never only clean them), re-tighten per Section 8 and re-test. A low flange-to-flange reading with good stud readings points to the gasket or to an external bridge (earth strap, instrument tubing, cable tray, support).



10. Hydrotest, commissioning and re-torque

Hydrotest water is conductive and can mask or cause isolation faults, so test electrically before filling and again after draining and drying:

1. Hydrotest at the pressure and hold time of the piping code; the kit must be rated for the test pressure (typically $1.5 \times$ design for ASME B31.3 / B31.4 / B31.8 systems, per the governing code).
2. Inspect for leaks at the gasket OD and at each stud. Do not tighten under pressure to stop a leak; depressurize first.
3. Drain and dry the bore across the joint; residual water or scale bridging the gasket ID gives a false low reading.
4. Repeat the Section 9 tests and record the results.
5. Re-torque after start-up only where the manufacturer recommends it (typically high temperature or thermal cycling), at 100 % target in a rotational pass, with the line depressurized and at ambient temperature, under an approved procedure. Never hot-torque or live-torque an isolating joint.
6. Re-energize CP, wait for polarization, and confirm isolation by the potential method (Section 9.2).
7. Where the electrolyte is conductive (water, wet gas, brine), the project may require internal lining of the pipe on both sides of the joint to limit internal current bridging; confirm this was done before commissioning.

11. Prohibited practices and common failure

Most isolation failures trace to one of the causes below; each is avoidable at installation:

Prohibited practice	Resulting failure
Pulling misaligned flanges together with the studs	Cracked sleeves or washers; stud-to-flange short; uneven gasket stress and leak
Using a generic flange torque chart	Crushed phenolic retainer or washers; loss of isolation
Impact wrench or hammer-wrenching	Cracked G10/phenolic washers
Nut bearing directly on an isolating washer (steel washer omitted)	Washer torn by nut rotation; short
Conductive anti-seize on sleeves, washers or gasket	Conductive path across the joint
Sleeve too short or too long	Exposed stud in the bolt hole, or sleeve crushed by the steel washer
Welding with return current through the joint, or welding near an installed kit	Carbonized isolating material; heat damage
Installing wet or contaminated phenolic components	Low insulation resistance
Re-using sleeves, washers or gasket	Hidden cracks; compression set; leak or short
Bridging the joint with earth straps, instrument tubing, conduit, supports or handrails	Joint isolated but CP shorted externally
Tightening under pressure or at temperature	Personal injury; overload of isolating components

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Installation record sheet

Complete one sheet per joint and hand it over with the joint tag number; without it the installation cannot be audited:

Item	Entry
Project / line number / joint tag	
Flange standard, size, class, facing	
Kit type (E/F/D), retainer, seal, sleeve, washer configuration	
Kit batch / certificate number	
Stud and nut grade, size, length, quantity	
Lubricant (name) and nut factor K	
Target torque (N·m) and source table / revision	
Torque tool serial number and calibration due date	
Face condition and finish (Ra) — acceptable Y/N	
Alignment: offset / parallelism / rotational (mm)	
Sleeve fit and sleeve length check — Y/N	
Passes 1–4 completed (date, time)	
Check pass (date, time, ≥ 4 h after pass 4)	
Gap readings at 4 points after final pass (mm)	
Insulation resistance, each stud to flange A / B (M Ω , test voltage)	
Flange-to-flange resistance (M Ω , test voltage) or alternative method and result	
Post-hydrotest re-test result	
Pipe-to-soil potentials both sides, CP on / instant-off (mV CSE)	
Assembler name and qualification	
CP technician name	
Inspector name, signature, date	