6 Industry COA Test Standard Manual for Sulfolane (Chinese Domestic & International Dual Specification System)

Preface

Certificate of Analysis (COA) acts as the sole quality certificate for import/export, incoming acceptance and factory release. Domestic testing is governed by GB/T 23946-2009 Industrial Sulfolane together with general chemical national standards. International testing is divided into five systems:

Petroleum Refining ASTM/UOP, Pharmaceutical ICH, Lithium/Electronics SEMI, EU REACH and US TSCA. COA index limits and test protocols differ drastically across downstream industries.

CAS No.: 126-33-0; Common English Name: Sulfolane / Tetramethylene sulfone

Part 1 Domestic Chinese Test Specifications for COA Issuance (Domestic Production & Domestic Sales / Raw Material Incoming Inspection)

1.1 Core National Standard GB/T 23946-2009 Industrial Sulfolane

Two grades defined: Premium Grade & First Grade; this standard must be marked on all domestic factory COAs for aromatic extraction and gas sweetening.

Test Item	Premium Grade (Main Export & Large Refineries)	First Grade (Small Unit Internal Circulation)	Supporting Domestic National Test Standard
Sulfolane mass fraction (dry GC)	≥99.5 wt%	≥99.0 wt%	GB/T 23946 GC internal standard, DB-Wax capillary FID
Water mass fraction	≤0.05 wt% (500 ppm)	≤0.30 wt% (3000 ppm)	GB/T 6283 Volumetric Karl Fischer
APHA Color	≤10	≤30	GB/T 3143 Platinum-Cobalt Colorimetry for Liquids
Total Acid Value (mgKOH/g)	≤0.1	≤0.3	GB/T 12008.4 Isopropanol potentiometric titration
2-Cyclobutene sulfone impurity	≤0.05 wt% (500 ppm)	≤0.10 wt%	GC normalized trace impurity test
Non-volatile residue	≤0.01 wt%	≤0.02 wt%	GB/T 2397 Vacuum constant mass evaporation
Density (30°C, g/cm³)	1.260~1.268	1.258~1.270	GB/T 4472 Digital densimeter

Test Item	Premium Grade (Main Export & Large Refineries)	First Grade (Small Unit Internal Circulation)	Supporting Domestic National Test Standard
Solidification Point	27.0~27.8°C	26.0~28.0°C	GB/T 3145 Crystallization point test

1.2 Domestic Internal Control COA Standards for High-Purity / Polymer / Pharmaceutical Grade (No Independent National Standard, Industry Unified Benchmarks)

For PEEK high-temperature polymerization and API export supporting materials, COAs shall mark internal high-purity enterprise standards:

1. GC purity ≥99.90 wt%
2. Water ≤50 ppm (GB/T 6283 coulometric Karl Fischer)
3. Single metal (Na, K, Fe, Ca, Cu) ≤3 ppm (GB/T 23947 AAS)
4. Total acid value ≤0.08 mgKOH/g
5. APHA color ≤10
6. 2-cyclobutene sulfone ≤50 ppm
7. Chloride ion ≤1 ppm (GB/T 3049 Ion Chromatography)

1.3 Domestic Internal Control COA Standard for Lithium Battery Electronic Grade (Semiconductor & High-Voltage Electrolyte)

Unified acceptance indexes for domestic lithium & wafer fabs, referenced to wet electronic chemical industry specifications:

1. Dry GC purity ≥99.99 wt%
2. Water ≤10 ppm (coulometric KF, 18.2 MΩ ultra-pure water electrolyte formulation)
3. Single metal (Li, Na, K, Mg, Ca, Fe, Cu, Zn, Al) ≤1 ppb (ICP-MS, ppt detection limit)
4. Total acid value ≤0.03 mgKOH/g
5. APHA color ≤5
6. Free sulfur & sulfide ≤0.5 ppb
7. Thermal stability SO_2 release ≤1 mg/kg
8. Particle count (0.5 μm) ≤10 particles/mL

1.4 Mandatory Additional Compliance Test Items for Domestic COAs

1. GHS hazard classification complying with GB 30000 series; SDS attached per GB/T 16483 & GB/T 17519 together with COA for domestic sales

2. Heavy metal limits per GB 38400 industrial pollutant discharge standards for factory release inspection
3. Hazardous goods judgment: COA must clearly state sulfolane is classified as non-hazardous chemical

1.5 Mandatory COA Test Items by Domestic Downstream Industry

1. Petroleum Refining (Aromatic Extraction / Gas Sweetening): Full GB/T 23946 indexes, water, acid value and 2-cyclobutene sulfone as core pass/fail criteria
2. PEEK Polymerization / Pharmaceutical Production: Add metal ion, trace water and chloride ion testing
3. Lithium Battery Electronic Grade: ICP-MS metal, trace water, particle count and thermal stability data mandatory

Part 2 International Test Specifications for Export COAs (Europe, America, Japan, South Korea, Southeast Asia)

2.1 Petroleum Refining International Standards (UOP Process, Chevron Phillips Original Sulfolane W Benchmark, Global Refinery COA Universal)

2.1.1 UOP Standard Test Methods (Global Benchmark for Aromatic Extraction Export COAs)

- UOP 481 Water Content Test
- UOP 599 Thermal Stability (SO_2 release test for thermal decomposition risk evaluation)
- UOP 960 GC purity & 2-cyclobutene sulfone quantification

2.1.2 ASTM Test Methods (Adopted uniformly by SGS, Intertek global third-party labs for export COAs)

表格

Test Index	**ASTM Standard No.**	**Applicable Scenario**
Density (30°C)	ASTM D4052	All industrial sulfolane grades
Distillation Range	ASTM D1078	Purity auxiliary judgment: 5% distillate ≥282°C, 95% distillate ≤288°C
Platinum-Cobalt Color	ASTM D1209	Global unified color evaluation
Total Sulfur Content	ASTM D5453	Total sulfur 26.0~27.0 wt% (water-free base)
Acid Value Titration	ASTM E222	Isopropanol KOH potentiometric titration

2.1.3 Overseas Industrial Grade COA Limits (Chevron Phillips Sulfolane W Original Standard)

- Primary component ≥99.0 wt%
- Water ≤0.3 wt%
- 2-cyclobutene sulfone ≤0.05 wt%
- Thermal stability SO_2 release ≤16 mg/kg
- APHA color ≤30

2.2 International COA Specifications for Pharmaceutical Export (ICH Q3C, USP, EP Pharmacopoeia System)

2.2.1 ICH Q3C (R9) Mandatory Residual Solvent Rules

Sulfolane categorized as Class 2 solvent, PDE = 1.6 mg/day, finished product residual limit 160 ppm. Mandatory COA content:

1. GC purity of raw sulfolane + full organic impurity chromatogram
2. ICH Q3D elemental heavy metal testing via ICP-MS (Na, K, Fe, Pb, As, Cd, Hg)
3. Water content, acid value, unsaturated 2-cyclobutene sulfone impurities

2.2.2 USP / EP European Pharmacopoeia Supporting Test Protocols

- Headspace GC for sulfolane residual testing in finished APIs
- Potentiometric titration for total organic acid
- ICP-MS trace heavy metal quantification

2.2.3 Hard Mandatory Rules for Pharmaceutical Export COAs

COA must state compliance with ICH Q3C, no SVHC high-concern impurities, and provide REACH registration number upon request.

2.3 Lithium Battery & Semiconductor International Standards (SEMI, ECS, RoHS, EU Battery Regulation 2023/1542)

2.3.1 SEMI Wet Electronic Chemical Specifications (Benchmark for Wafer Cleaning & Electronic Solvent COAs)

- All single metal ions ≤1 ppb
- Trace water ≤10 ppm via coulometric KF titration
- 0.5 μm particle counting, IC test for Cl^- & SO_4^{2-} anions

2.3.2 Power Battery Supporting International Standards

- IEC 62133 lithium battery safety standard impurity control requirements
- RoHS 2.0 & EU 2023/1542 battery regulation restricting Pb/Cd/Hg heavy metals; COA must report ND (Not Detected) results for heavy metals

2.3.3 Unified Overseas Electronic Grade COA Limits

Purity ≥99.99 wt%; single metal ≤1 ppb; water ≤10 ppm; APHA color ≤5

2.4 Mandatory REACH Compliance Items on All EU Export COAs

1. Unique REACH registration number of sulfolane: 01-2119565139-32-0000, printed on COA header
2. SVHC Substance of Very High Concern screening statement: Sulfolane not listed in SVHC candidate list
3. CLP GHS hazard classification data consistent with SDS (Regulation 2020/878)
4. Quantified data for 2-cyclobutene sulfone, sulfonic acid degradation products and heavy metal impurities

2.5 US TSCA, Japan & South Korea Local Standards

1. US TSCA: COA must mark sulfolane listed under TSCA inventory to prove US import compliance
2. Japan METI ENCS & South Korea KECI: COA shall display domestic chemical registration numbers; impurity limits aligned with UOP + ASTM combined standards

Part 3 Domestic vs International COA Core Comparison Table

表格

Comparison Dimension	**Domestic Chinese COA System**	**International Export COA System (EU & US)**
Governing Standard	GB/T 23946-2009 Industrial Sulfolane	UOP 599 / UOP 481, ASTM series, ICH Q3C, SEMI
Purity Test Method	GC internal standard DB-Wax column	UOP proprietary GC-FID, full chromatogram attached
Water Testing Hierarchy	Volumetric KF for industrial grade; coulometric KF for high-purity/electronic grade	Coulometric KF mandatory for all grades, ppm/ppb precision
Metal Testing	AAS for industrial; ICP-MS for electronic grade	ICP-MS mandatory for all high-purity & electronic grades, ppb reporting
Pharmaceutical Compliance Basis	Only internal enterprise control, no national pharmacopoeia standard	ICH Q3C residual solvent limits legally mandatory
Compliance Documents Attached	GB domestic SDS, domestic hazardous goods classification	REACH registration, SVHC screening, CLP-GHS, RoHS
Recognized Third-Party Labs	CMA & CNAS certified labs	SGS, Intertek, Bureau Veritas (BV)

Comparison Dimension	Domestic Chinese COA System	International Export COA System (EU & US)
Thermal Stability Test	Sampling test only for high-end products	Mandatory per export batch via UOP 599 SO_2 release test

Part 4 Universal COA Issuance Rules (Domestic & International Shared)

4.1 Mandatory Header Information (All Grades, No Exception)

Product name Sulfolane, CAS 126-33-0, Batch No., Production Date, Sampling Date, Test Date, Product Grade (Industrial / Polymer / Electronic), Applicable Standard No., Supplier Full Details

4.2 Result Judgment Logic

- Domestic: Pass if meeting GB/T 23946 Premium/First Grade limits; high-purity & electronic grades judged against enterprise internal control standards
- International: Qualified only when simultaneously complying with UOP/ASTM indexes plus industry-specific regulations (ICH/SEMI/REACH)

4.3 Abnormal Data Labeling Specifications

- ND = Not Detected, instrument detection limit (MDL) marked alongside
- Pass / Fail marked after each single index
- Separate isolation COA issued for non-conforming batches, prohibited from circulation & shipment

Part 5 COA Selection Guide by Application Scenario

1. Domestic Refinery Aromatic Extraction / Gas Sweetening: COA per full GB/T 23946 national standard
2. Domestic PEEK Polymerization / API Production: National standard plus internal high-purity metal & trace water indexes
3. Export to Middle East & Southeast Asian Refineries: Dual-standard COA complying with UOP + ASTM
4. Export EU Pharmaceutical API Factories: Combined COA with ICH Q3C + REACH + ASTM compliance
5. Export EU & US Lithium Battery / Semiconductor Manufacturers: Full electronic-grade COA meeting SEMI + RoHS standards