SEALS AND O-RINGS MICROCONTAMINATION ANALYSIS

AS PER SEMI F51-1115

As standards are being developed to help the global semiconductor industry for ever shrinking technologies, O-rings and seals need a new level of scrutiny in terms of sealing requirements and impurities such as inherent inorganics and organics which are micro-contamination concerns for front-end process (FEP) tools. A critical need to institute their purity through an established analytical protocol is of utmost importance.

ChemTrace® offers extensive experience in qualification and monitoring of seals and O-rings as per SEMI F51-1115 for impurities such as Leachables (anions, trace metals), Ash (bulk trace metals), Outgassing (volatile organics) and TOC. Particle shedding is not listed as a requirement in SEMI, however, can be analyzed by UPW extraction method followed by LPC.

WHY O-RINGS ANALYSIS?

Seals Manufacturers:

- Quality control of finished products
- Establish product differentiation
- Qualify new process/material

End users:

- Compare O-rings suppliers
- Qualify O-rings for process specific applications.

TABLE 1. TRACE METAL ANALYSIS OF O-RINGS FROM THE SAME VENDOR USING LEACHABLE AND ASHING TECHNIQUES FOLLOWED BY ICP-MS

Elements		MDL	Leachable Trace Metals	MDL	Ashing (Bulk Trace Metals)
		µg/m²		*ppb (ng/g)*	
Aluminum	(Al)	0.2	3200	2	800,000
Barium	(Ba)	0.2	34	2	13,000
Calcium	(Ca)	0.5	1500	2	1,100,000
Chromium	(Cr)	0.2	6.2	0.5	1,600
Copper	(Cu)	0.1	62	1	1,100
Iron	(Fe)	0.2	190	1	410,000
Lithium	(Li)	0.02	0.25	2	1,100
Magnesium	(Mg)	0.2	650	5	110,000
Manganese	(Mn)	0.05	12	5	1,300
Nickel	(Ni)	0.1	9.0	1	1,500
Potassium	(K)	0.3	1200	2	71,000
Sodium	(Na)	0.2	570	2	55,000
Strontium	(Sr)	0.07	19	2	10,000
Titanium	(Ti)	0.2	58	2	6,900
Vanadium	(V)	0.04	0.85	2	1,900
Zinc	(Zn)	0.2	110	2	1,900
Zirconium	(Zr)	0.008	4.2	2	1,500

**Expansive list (up to 25E) available upon request.*

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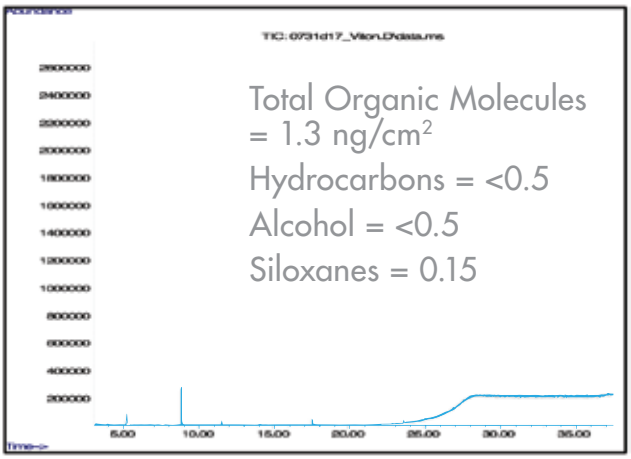
TABLE 2. LEACHABLE ANIONS AND CATIONS BY ION CHROMATOGRAPHY

Elements		MDL	Vendor A Seal	Vendor B Seal
Anions:			*µg/m²*	
Fluoride	(F^-)	1	320	560
Chloride	(Cl^-)	1	110	40
Nitrite	(NO_2^-)	1	1.3	<1
Bromide	(Br^-)	0.75	5.6	7.2
Nitrate	(NO_3^-)	1.5	9.3	1.9
Sulfate	(SO_4^{2-})	1.5	1,800	100
Phosphate	(PO_4^{3-})	1.5	8.8	16
Cations:				
Lithium	(Li^+)	1	<1	<1
Sodium	(Na^+)	1	120	81
Ammonium	(NH_4^+)	1	41	36
Potassium	(K^+)	1	<1	12
Magnesium	(Mg^{2+})	1	31	20
Calcium	(Ca^{2+})	1	2,300	820

TABLE 3. O-RING EVALUATION FOR TOC

MDL	Seal Vendor A	Seal Vendor B
	µg/m²	
1500	5,700	14,000

GRAPH 1A. ANALYSIS OF SEAL MATERIAL BY ATD GC-MS. CHROMATOGRAM FOR SEAL VENDOR A



GRAPH 1B. ANALYSIS OF SEAL MATERIAL BY ATD GC-MS. CHROMATOGRAM FOR SEAL VENDOR B

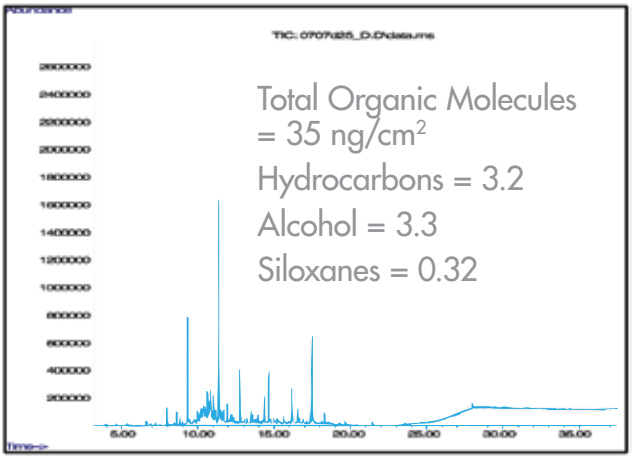


TABLE 4. O-RING EVALUATION FOR PARTICLE SHEDDING

Particle Size	O-ring #1	O-ring #2
	counts/cm²	
> 0.2 µm	3625	7312
> 0.3 µm	2431	2190
> 0.5 µm	200	278
> 1.0 µm	11	17
> 2.0 µm	1	2