



SAE J2975 & J866

Copper, heavy metals, and asbestos
detection for environmental markings

single-source service for friction edge-code and
environmental markings testing

integrated testing service from initial debris extraction
to test report with A, B, or N letter coding

approved third-party testing facility by U.S. industry
registrars for California and Washington requirements

www.linkeng.com

typical uses for SAE J2975

SAE J2975 testing and its report with the environmental letter coding per SAE J866 are valuable tools to:

- determine the level of compliance to state rules and regulations for heavy metals and asbestiform fiber content

- compare different friction material formulations, production batches, or manufacturing sites

- support the declaration of conformity requirements for vehicle manufacturers, distributors, wholesalers, retailers, installers, and friction material suppliers

debris extraction



debris extraction per SAE J2975 drilling and layout parameters using standard drilling sequence:

- standardized and efficient process for common applications (D-numbers)

- ensures uniform and repeatable drilling pattern and depth to minimize results variability from different drilling techniques

- ensures chain-of-custody and traceability to the original sample while eliminating the delays from outsourced drilling (or manufacturer's internal drilling process)

digestion



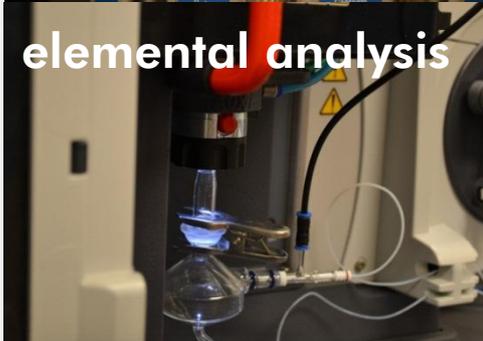
microwave digestion for rapid, high-pressure, high-temperature preparation of samples for ICP-OES:

- using encapsulated vessels with acid mix per SAE/EPA standard method

- 1,200 W; 2,45 MHz high-frequency; up-to-800 psi (54 atm); and up-to-240 °C cycle

- batch processing with real-time monitoring, automated cycle, and fixed digestion time

elemental analysis



inductively coupled plasma and optical emission spectrometry (ICP-OES) for simultaneous analysis of large number of trace elements:

- using auto-sampling system for automated batch operation, including quality control testing samples (blanks and spiked) for each analyte

- charge injection device with solid state camera with large dynamic range and dual-wavelength measurement

- Cr⁺⁶ detection with alkaline digestion and absorption spectrophotometer unit

asbestos detection



asbestiform fiber detection using polarized light microscopy (EPA-PLM):

- high-resolution digital imaging system and control software

- 1,000-point count with birefringence and dispersion staining techniques

- documentation of fiber finding with digital pictures as part of test report



SAE J866 and chemical summary

overall assessment with an intuitive, easy-to-understand tabular summary to answer two questions (1) what is the level of compliance of a given formulation or batch, and (2) which were the individual results for each replicate

- a**: average level measured on the three replicates (three samples) for the same formulation from the same manufacturing process
- b**: limit values for each applicable element per SAE J866 and in accordance with the California and Washington state rules and regulations
- c**: standard letter designation (A, B, or N) for the material as a function of percent-by-weight and the specific percent-by-weight of copper
- d**: smallest measurable value of concentration and percent-by-weight for each element
- e**: individual results for each test replicate

Material Summary and Designation

Chemical analysis summary		Method	Average / %	Limit / %	Designation
Cadmium and its compounds	Cd	LINK-3051B/6010C	ND	0.01	B
Chromium (total)	Cr	LINK-3051B/6010C	0.083	note 1	n.a.
Chromium-VI salts	Cr ⁶⁺	LINK-3060A/7196A	n.a.	0.1	B
Lead and its compounds	Pb	LINK-3051B/6010C	0.017	0.1	B
Mercury and its compounds	Hg	LINK-3051B/6010C	ND	0.1	B
Asbestiform fibers	—	LINK-600/93/116/PLM	n.a.	note 2	B
Copper and its compounds	Cu	LINK-3051B/6010C	4.85	note 3	B
Antimony	Sb	LINK-3051B/6010C	1.71	note 4	n.a.
Nickel	Ni	LINK-3051B/6010C	0.0057	note 4	n.a.
Zinc	Zn	LINK-3051B/6010C	2.05	note 4	n.a.

SAE J866:2012 material designation:

B

Elemental Analysis with Individual Results

Chemical Analysis Summary	Detection limit		e ¹ 123205-1		e ² 123205-2		e ³ 123205-3		average		
	mg/kg	%w/w	mg/kg	%w/w	mg/kg	%w/w	mg/kg	%w/w	mg/kg	%w/w	
Cadmium and its compounds	Cd	2.5	0.00025	ND	ND	ND	ND	ND	ND	ND	
Chromium (total)	Cr	2.5	0.00025	848	0.085	915	0.092	731	0.073	832	0.083
Chromium-VI salts	Cr ⁶⁺	50.0	0.005	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lead and its compounds	Pb	25.0	0.0025	170	0.017	165	0.016	169	0.017	168	0.017
Mercury and its compounds	Hg	25.0	0.00250	ND	ND	ND	ND	ND	ND	ND	ND
Copper and its compounds	Cu	25.0	0.00250	49821	4.982	45721	4.572	49812	4.981	48451	4.85
Antimony	Sb	250.0	0.0250	16715	1.672	14514	1.451	20132	2.013	17120	1.71
Nickel	Ni	2.5	0.00025	56	0.0056	56	0.0056	57	0.0057	57	0.0057
Zinc	Zn	250.0	0.0250	20412	2.041	20904	2.090	20116	2.012	20478	2.05

Asbestos Detection with Individual Results

Asbestos Method Summary	Detection limit	test 1	test 2	test 3	average
		123205-1	123205-2	123205-3	%
Asbestiform fibers (PLM)	—	0.1	ND	ND	ND
Asbestiform fibers (TEM)	—	n.a.	n.a.	n.a.	n.a.

NOTES

- 1: no limit specified
- 2: 0.1% for PLM. If detected by PLM, the quantity is verified by TEM
- 3: A = n.a.; 0.5 < B ≤ 5; N ≤ 0.5
- 4: for reference only for WA

LEGENDS:

- *: marks an element with an average content above the stated limit
- n.a.: not applicable (or not measured) for the tested material
- ND: Non Detected. Actual value is below the measurable value
- %w/w: percent by weight per measurement method for a particular element

summary of friction and chemical testing services

Link Engineering Co. – Laboratory Testing Services has a unique position to provide a single-source for friction material testing and certification per SAE J886 testing in accordance to VESC-V-3 (friction level) and SAE J2975 (chemical and asbestos analysis). These measurements allow the supplier to demonstrate compliance to the California and Washington state upcoming limits on heavy metals and asbestos in friction materials.

Link’s business model already includes the best practices from third-party laboratory testing per ISO 17025, specific to automotive friction materials. This is unique to our proposal compared to other potential bodies or agencies with certification background.

Lastly, our international network of testing facilities allows local interaction with customers outside the U.S.

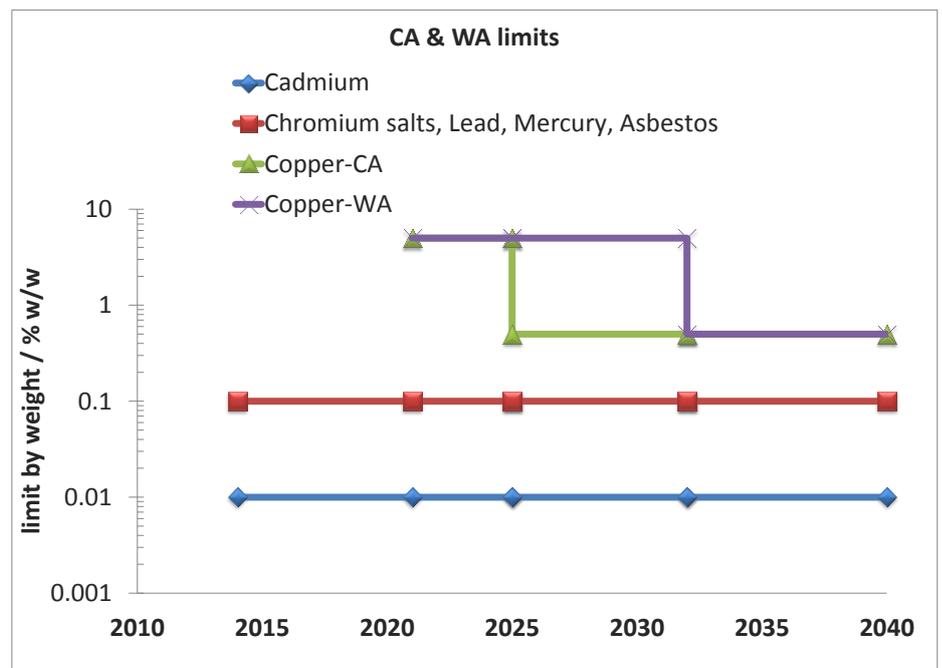
- Single-source, avoiding multiple laboratories, duplicate logistics, and additional shipping costs
- Entire sample preparation (coupon for friction test and debris for chemical element measurements) and testing process within Link to avoid variation due to different sample (and debris) preparations
- Friction and chemical laboratories specialized on friction material testing and measurements
- Use of latest-technology for CNC-automated drilling, sealed/high-pressure acid digestion, automated spectrometer analysis, and asbestos detection with high-resolution microscopes with digital imaging

timeline for limits by state and by constituent

the two states currently with limits and future bans on heavy metals and asbestiform fibers on friction materials are California and Washington

the industry and different organizations are cooperating with state ecology departments to educate the public and to gain consensus with federal agencies for a comprehensive endorsement of current state rules

antimony, nickel, and zinc, will be initially monitored, not regulated



Brimley, Canton, Dearborn, Detroit, Plymouth, **Michigan** – Los Angeles, **California**
 Stanfield, Wittmann, Yucca, Yuma, **Arizona** – East Liberty, **Ohio** – Laurel Mtn., **Pennsylvania**
 Limburg, **Germany** – Manchester, **UK** – Paris, **France** – Chennai, **India**
 Seoul, **Korea** – Shanghai, **China** – Sorocaba, **Brazil** – Tokyo, **Japan**