in cooperation with the WG 'Precious Metals'
of the Committee of Chemists of GDMB

CERTIFICATE OF ANALYSIS

ERM®-EB504a

Platinum Group Elements in Used Automobile Catalyst		
	Certified value [1]	Uncertainty [2]
Element	Mass fraction in mg/kg	
Pt	1414	9
Pd	1596	11
Rh	210.0	2.2

[1] Unweighted mean value of the means of accepted sets of data, each set being obtained in a different laboratory and/or with a different method of determination. The values are traceable to the SI (Système International d'Unités) by the use of pure substances of known stoichiometry for calibration. Before analysis the material was dried for 8 h at 105 °C.

[2] Estimated expanded uncertainty *U* with a coverage factor of $k = 2$, corresponding to a level of confidence of about 95 %, as defined in the ISO/IEC Guide 98-3:2008 [Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)].

This certificate is valid until 10/2036.
The minimum sample size for wet chemical analysis is 5 g.

Accepted as an ERM®, Berlin, 2016-09-07

BAM Department 1
Analytical Chemistry;
Reference Materials

BAM Division 1.6
Inorganic Reference Materials

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(Head of Department)

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BAM holds an accreditation as a reference material producer according to ISO Guide 34 in combination with ISO/IEC 17025. This accreditation is valid only for the scope as specified in the certificate D-RM-11075-01-00.

DAkkS is a signatory of the multilateral agreement (MLA) between EA, ILAC and IAF for mutual acceptance.

DAkkS Deutsche Akkreditierungsstelle D-RM-11075-01-00

NOTE

European Reference Material ERM®-EB504a was certified under the responsibility of Bundesanstalt für Materialforschung und -prüfung (BAM) in cooperation with the Committee of Chemists of the GDMB Society of Metallurgists und Miners according to the principles laid down in the technical guidelines of the European Reference Materials® co-operation agreement between BAM-LGC-IRMM. Information on these guidelines is available on the Internet (http://www.erm-crm.org).

DESCRIPTION OF THE SAMPLE

The material is a mixture of used automobile catalysts supplied and prepared by a commercial manufacturer. The material was ignited, ground to a particle size below 100 µm and homogenised thoroughly before bottling in 200 g units in screw cap amber glass bottles. The carbon content is ca. 1.75 %.

INTENDED USE

This material is intended for use as a reference material in the development, validation or quality control of analytical methods for the determination of Platinum group elements (PGE) in automobile catalysts. The material may also be applicable to other matrices where suitable reference materials are not available.

Information on how to compare an analytical result with the certified value can be found in ERM Application Note 1; www.erm-crm.org

INSTRUCTIONS FOR USE

Prior to use, the material should be thoroughly mixed by several inversions of the bottle. Before weighing, the material has to be dried for 8 h at 105 °C.

STORAGE

The material should be stored at ambient conditions in a dry and clean environment.

PARTICIPANTS

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ReMetall Deutschland AG, Drochow (Germany)
Saxonia Edelmetalle GmbH, Halsbrücke (Germany)
Umicore AG, Hanau (Germany)
Umicore Precious Metals, Hoboken (Belgium)
WRC World Resources Company GmbH, Wurzen (Germany)

MEANS OF ACCEPTED DATA SETS (FOR ONE METHOD AT ONE LABORATORY, RESPECTIVELY)

Mass fraction in mg/kg

Line No.	Pt	Pd	Rh
1	1390.0	1571.5	203.6
2	1399.2	1572.5	204.9
3	1405.3	1573.8	205.5
4	1406.3	1579.0	207.3
5	1408.8	1583.3	208.1
6	1409.0	1586.5	208.4
7	1409.5	1587.0	208.7
8	1409.8	1587.0	208.9
9	1409.8	1594.3	209.2
10	1412.0	1594.5	209.7
11	1415.2	1594.7	209.8
12	1415.3	1597.2	209.9
13	1415.8	1597.8	210.1
14	1416.8	1599.2	210.3
15	1416.8	1602.0	210.8
16	1416.8	1603.0	211.0
17	1418.2	1604.8	211.2
18	1419.0	1607.4	211.3
19	1420.7	1609.7	211.5
20	1423.5	1614.3	211.7
21	1429.2	1615.5	211.9
22	1438.5	1617.5	212.5
23		1623.7	213.7
24			214.6
25			215.0
M :	1414	1596	210.0
s_M:	10	15	2.8
$\overline{s_i}$:	7	9	2.0

M: mean of means of data sets
s_M: standard deviation of means of data sets*
$\overline{s_i}$: mean of standard deviations of individual data sets

*calculated from at least 3 but normally 6 single values

SAFETY GUIDELINES

Used car catalyst powder is not known to be toxic. No hazardous effect is to be expected if the material is used under conditions usually adopted in analytical laboratories when handling finely dispersed powder materials.

ANALYTICAL METHOD USED FOR CERTIFICATION

Element	Line no.	Method
Pt	1, 4, 15, 18	ICP-OES, after collection with tellurium
	2	XRF, after collection with copper
	3, 5, 8, 9, 11, 14	ICP-OES, after collection with copper
	6, 17, 19, 20	ICP-OES, after collection with nickel sulfide
	7, 10, 16, 21, 22	ICP-OES, after collection with lead
	12	SOES
	13	ICP-OES, after decomposition with Na_2O_2/HCl
Pd	1, 3, 5	ICP-OES, after collection with tellurium
	2	ICP-OES, after decomposition with Na_2CO_3/$Na_2B_4O_7$, collection with nickel
	4, 7, 8, 9, 16, 19	ICP-OES, after collection with copper
	6	XRF, after collection with copper
	10, 11, 14, 15, 23	ICP-OES, after collection with nickel sulfide
	12	ICP-OES, after decomposition with Na_2O_2/HCl
	13, 17, 21, 22	ICP-OES, after collection with lead
	18	ICP-OES, after dissolution with aqua regia
	20	SOES
Rh	1, 5, 9, 10, 11, 13, 15	ICP-OES, after collection with copper
	2, 12, 18, 21, 24	ICP-OES, after collection with lead
	3, 7, 8, 20	ICP-OES, after collection with tellurium
	4, 6, 16, 23, 25	ICP-OES, after collection with nickel sulfide
	14	SOES
	17	XRF, after collection with copper
	19	ICP-OES, after decomposition with Na_2CO_3/$Na_2B_4O_7$, collection with nickel
	22	ICP-OES, after decomposition with Na_2O_2/HCl

Abbreviations:

ICP-OES	Inductively coupled plasma optical emission spectrometry
SOES	Spark optical emission spectrometry
XRF	X-ray fluorescence spectrometry

TECHNICAL REPORT

A detailed technical report describing the analysis procedures and the treatment of the analytical data used to certify ERM®-EB504a is available on request.

Supply of Reference Materials by: Bundesanstalt für Materialforschung und -prüfung (BAM)

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