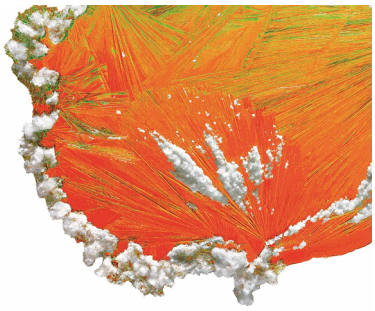


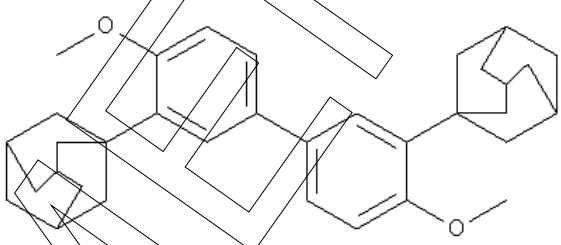
Certificate of Analysis

ISO 9001

Reference Material

Product name

1,1'-[4,4'Bis(methoxy)biphenyl-3,3'-diyl]bis(tricyclo[3.3.1.13,7]decane)



Product code
MM0681.02

Lot number
1030064

CAS number
932033-57-3

Appearance
white solid

Molecular weight
482.70

Melting point
287 °C

Molecular formula
$C_{34}H_{42}O_2$

Long-term storage
2 to 8 °C, dark

Assay "as is"
97.9 %

Date of shipment: **02 Sep 2019**

Producer confirms that this reference material (RM) meets the specification detailed on this Certificate of Analysis for **two years** from the date of shipment, provided the substance is stored under the recommended conditions unopened in the original container.

Release by:	**Date of Release:**		
Dr. Sabine Schröder	Luckenwalde, 12 Aug 2019		Product Release

Product information

For laboratory use only. Not suitable for human or animal consumption.

Before usage of the RM, it should be allowed to warm to room temperature. No drying required, as the certified value is already corrected for the content of water and other volatile materials.

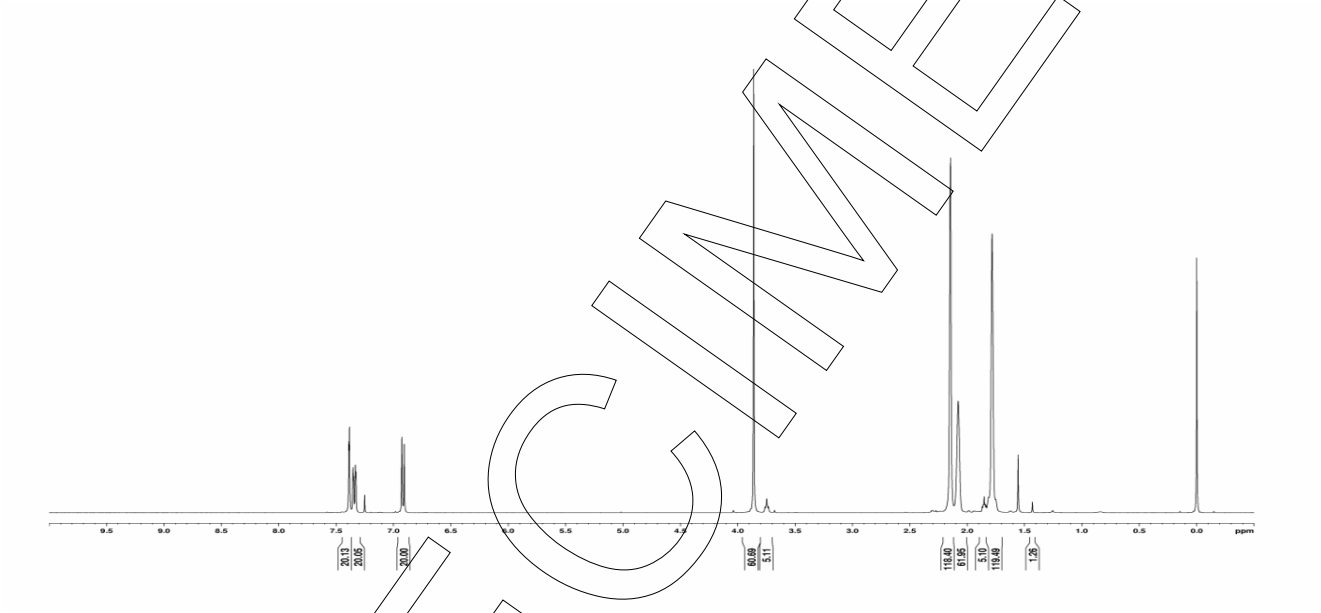
The product quality is controlled by regularly performed quality control tests (retests).

Further content

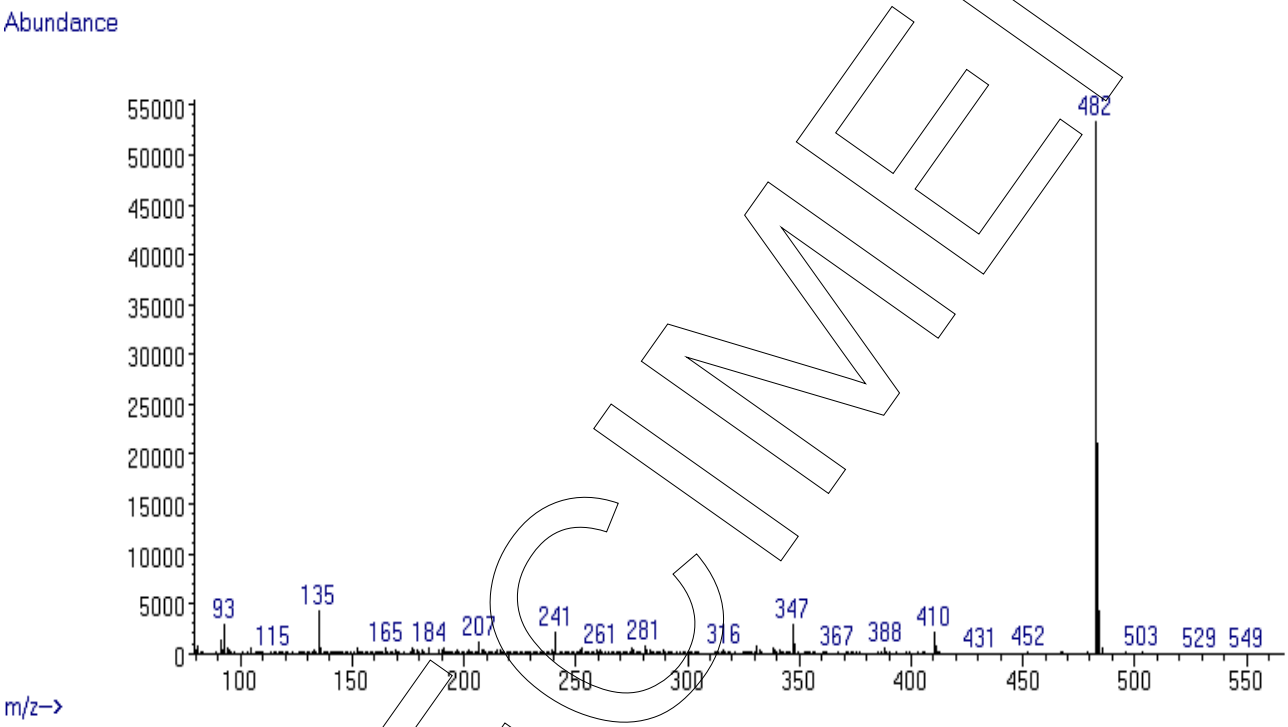
Identity

The identity of the reference material was established by following analyses.

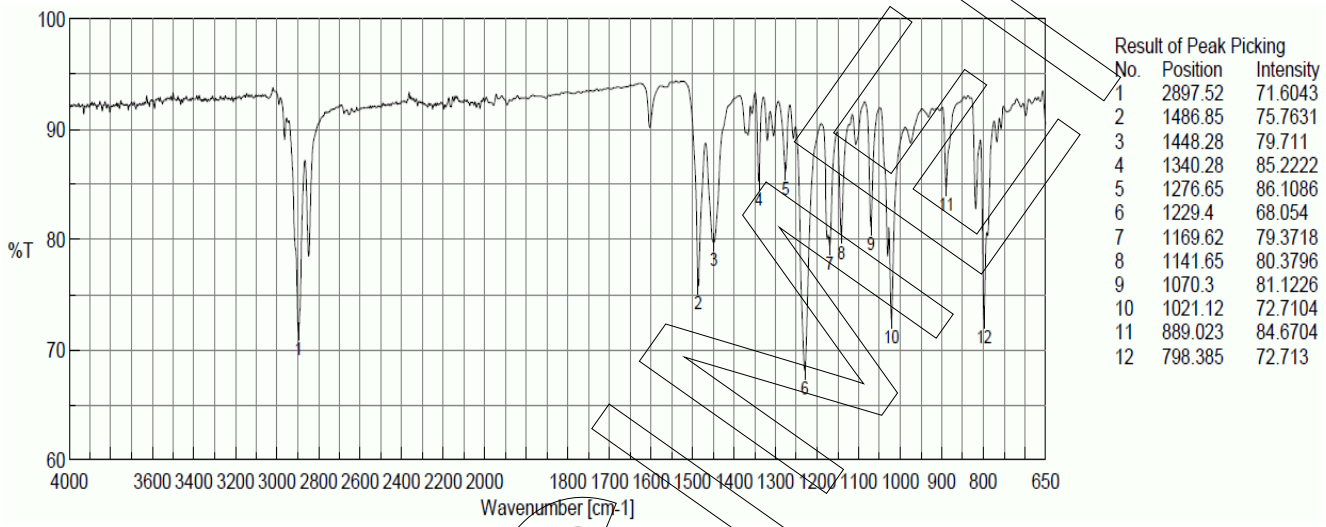
Method	Conditions	Result
^{1}H-NMR	400 MHz, $CDCl_3$	Structure confirmed



Method	Conditions	Result
MS	EI, 70eV, detector temperature: 280 °C	Structure confirmed



Method	Conditions	Result
IR	Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) Spectroscopy	Structure confirmed



Result of Peak Picking

No.	Position	Intensity
1	2897.52	71.6043
2	1486.85	75.7631
3	1448.28	79.711
4	1340.28	85.2222
5	1276.65	86.1086
6	1229.4	68.054
7	1169.62	79.3718
8	1141.65	80.3796
9	1070.3	81.1226
10	1021.12	72.7104
11	889.023	84.6704
12	798.385	72.713

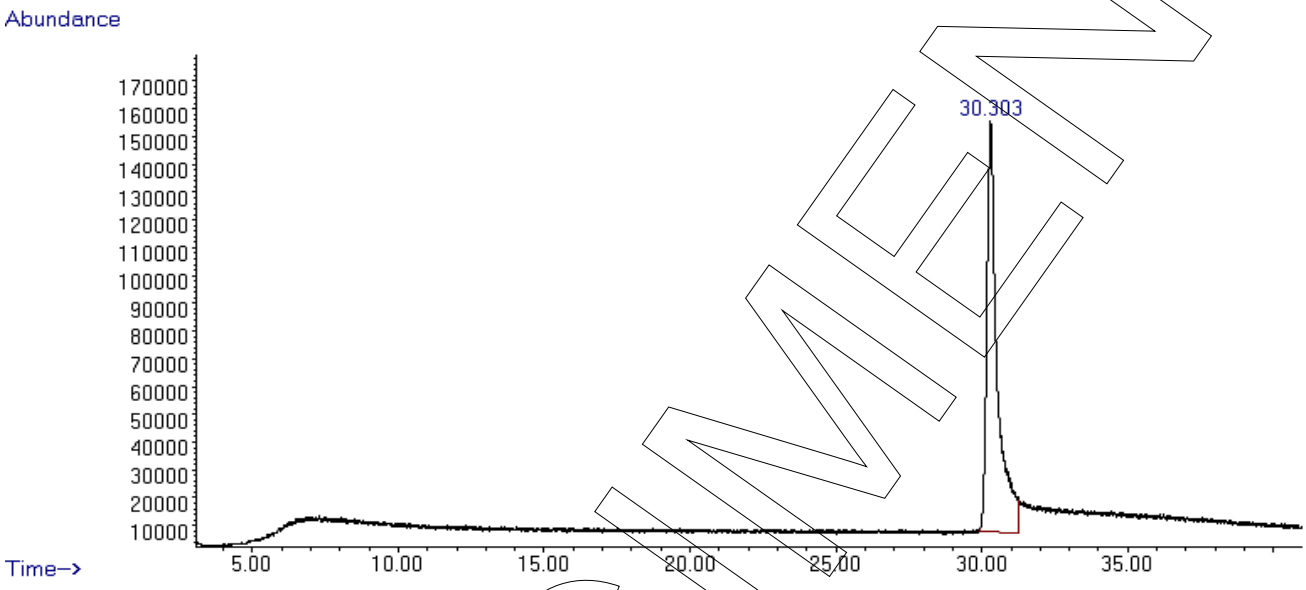
Assay

The assay of the reference material was assessed by following analyses.

Purity by Gas Chromatography (GC)

GC Conditions:	
Column	HP-5MS 30 m x 0.25 mm x 0.25 µm
Detector	EI, 70 eV; 35 to 550 amu; 280 °C
Injector	Split 20:1, 240 °C
Flow rate	Helium 1.50 ml/min
Oven program	Initial Temp.: 240 °C for 3 min Heating Rate: 20 °C/min Final Temp.: 300 °C for 35 min

GC chromatogram and peak table



Area percent report - sorted by signal				
Pk #	**Retention time**	**Area**	**Area %**	
1	30.303	36641109	100.00	
Totals		**36641109**	**100.00**	

The content of the analyte was determined as ratio of the peak area of the analyte and the cumulative areas of the purities, added up to 100 %. Air peaks were ignored in calculation.

Result (n = 3)	100.00 %; SD < 0.01 %

Volatile content

Water content	
Method	Karl Fischer titration
Result (n = 3)	0.06 %; SD < 0.01 %

Residual solvents	
Method	^{1}H-NMR
Result (n = 1)	Sum: 2.05 % 1.87 % Tetrahydrofuran; 0.18 % Cyclohexane

Final result

Assay "as is": 97.89 %

The assay "as is" is assessed by 100% method (mass balance) and is equivalent to the assay based on the not anhydrous and not dried substance respectively.

The calculation of the 100% method follows the formula:

$$\text{Assay (\%)} = (100\ \% - \text{volatile contents (\%)}) * \frac{\text{Purity (\%)}}{100\ \%}$$

Volatile contents are considered as absolute contributions and purity is considered as relative contribution. Inorganic residues are excluded by additional tests.

Revision table

Revision	Date	Reason for revision
00	13 Aug 2019	Release of the Certificate of Analysis - initial version

Product warranties for the RM are set out in the terms and conditions of purchase.