



Certificate of Analysis

Characterisation methods are accredited according to

ISO 17025

Reference Material

Product name

Chlorambucil

Product code

MM0821.00

CAS number

305-03-3

Molecular weight

304.21

Molecular formula

C₁₄H₁₉Cl₂NO₂

Lot number

W1016552

Appearance

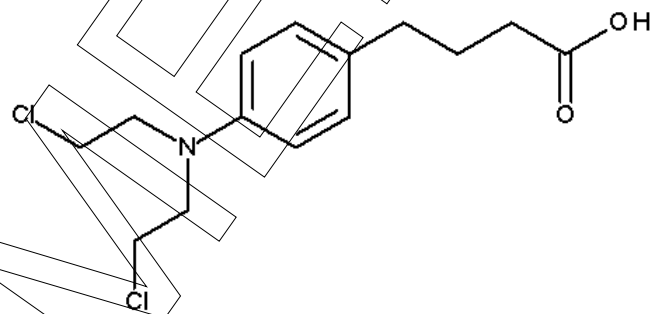
white solid

Melting point

67 °C

Long-term storage

2 to 8 °C, dark



Assay¹ "as is"
100.1 %

Uncertainty² U
0.4 %

Intended Use: Use for identification and quantification. The assay is verified by a second testing method.

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:		Product Release
Dr. Sabine Schröder	Luckenwalde, 06 Aug 2019		

¹ Calibration and verification were carried out using standards traceable to SI-units. The value is expressed on an "as is" basis.

² The uncertainty "U" is the expanded uncertainty of the testing method for the assigned value estimated in accordance with the Guide to the Expression of Uncertainty in Measurement (GUM). It corresponds to a level of confidence of about 95%. Coverage factor k=2.



Product information

This RM is intended for laboratory use only and is not suitable for human or animal consumption.

This RM conforms to the characteristics of a primary standard as described in the ICH Guidelines. The values quoted in this Certificate of Analysis are the producer's best estimate of the true values within the stated uncertainties and based on the techniques described in this Certificate of Analysis. The characterisation of this material was undertaken in accordance with the requirements of ISO/IEC 17025. The identity is verified by data from international scientific literature.

Storage and handling

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

Reference Material quality is controlled by regularly performed quality control tests (retests).

Further content

Assigned value

Purity

Identity

Revision table

SPECIMEN



Assigned value

Assay "as is": 100.10 %; U = 0.35 %

The assay "as is" is assessed by carbon titration of elemental analysis and is equivalent to the assay based on the not-anhydrous and not-dried substance. The assay is verified by 100% method (mass balance).

The verified result lies inside our acceptance criteria, i.e. less than 1.0 % difference to assay assigning technique.

For quantitative applications, use the assay as a calculation value on the "as is basis". The uncertainty of the assay can be used for estimation/calculation of measurement uncertainty.

Method 1: Value assigning technique - carbon titration of elemental analysis

Method	percentage carbon found in relation to percentage carbon as calculated for molecular formula
Results (mass fraction, n = 3)	100.10 %; U = 0.35 %

Method 2: Value verifying technique - 100% method

100% method (mass balance) with chromatographic purity by HPLC	
Result	99.26 %

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.

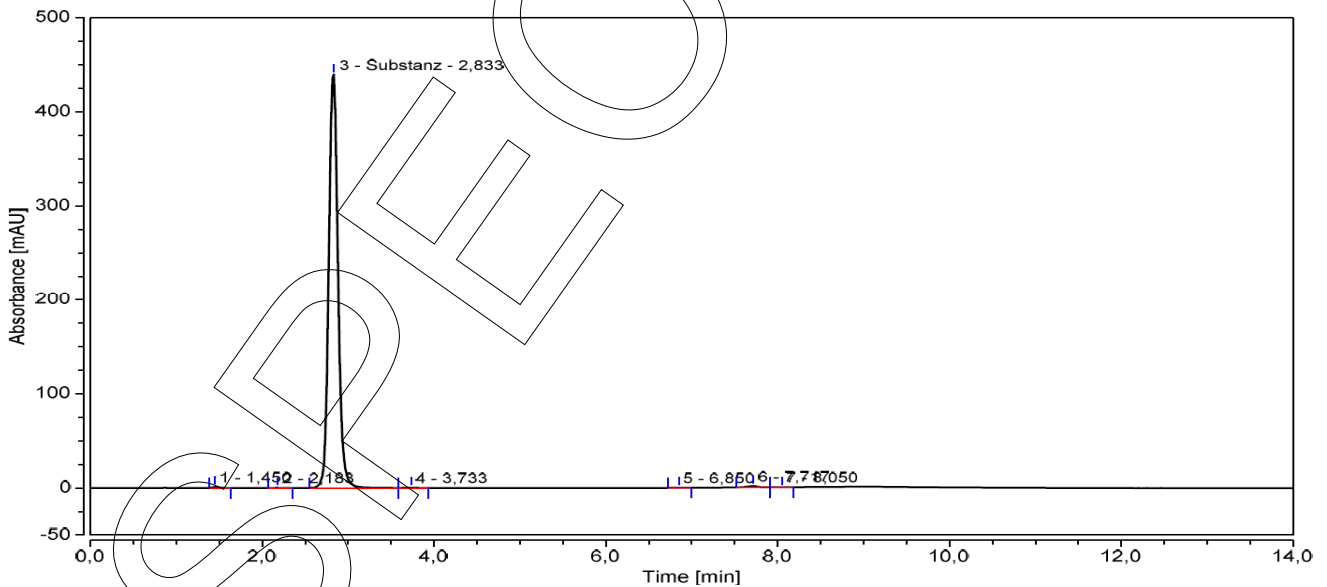


Purity

Purity by High Performance Liquid Chromatography (HPLC)

HPLC Conditions:	
Column	LiChrospher 60 RP-select B; 5 µm, 125 x 4.0 mm
Column temperature	40 °C
Detector	DAD, 260 nm
Injector	Auto 2 µl; 0.108 mg/ml in Acetonitrile/Water 50/50 (v/v)
Flow rate	1.0 ml/min
Phase A	Water, 0.1 % H ₃ PO ₄
Phase B	Acetonitrile, 0.1 % H ₃ PO ₄
Gradient program	0-4 min A/B 45/55 4-7 min A/B to 20/80 7-9 min A/B to 45/55 9-14 min A/B 45/55 (v/v)

HPLC chromatogram and peak table





Area percent report - sorted by signal

Pk #	Retention time	Area	Area %
1	1.450	0.078	0.14
2	2.183	0.010	0.02
3	2.833	55.020	99.32
4	3.733	0.055	0.10
5	6.850	0.031	0.06
6	7.7170	0.190	0.34
7	8.050	0.013	0.02
Totals		55.397	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 %. System peaks were ignored in calculation.

Result (n = 3) 99.31 %; U = 0.30 %

Volatile content

Water content

Method Karl Fischer titration
Result (n = 3) 0.05 %*; SD = 0.01 %

*not accredited testing method

Residual solvents

Method ¹H-NMR
Result (n = 1) No significant amounts of residual solvents were detected (< 0.05 %).*

*not accredited testing method



Inorganic residues

Method: Elementary analysis

Inorganic residues can be excluded by elementary analysis (CHN).

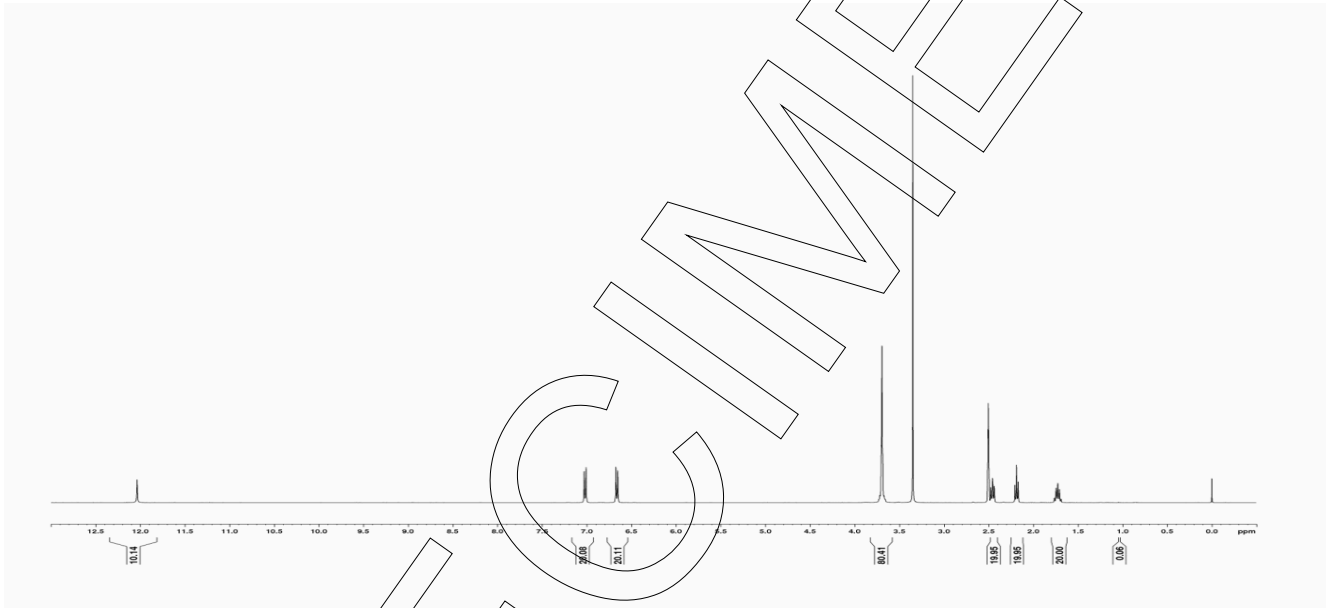
SPECIMEN



Identity

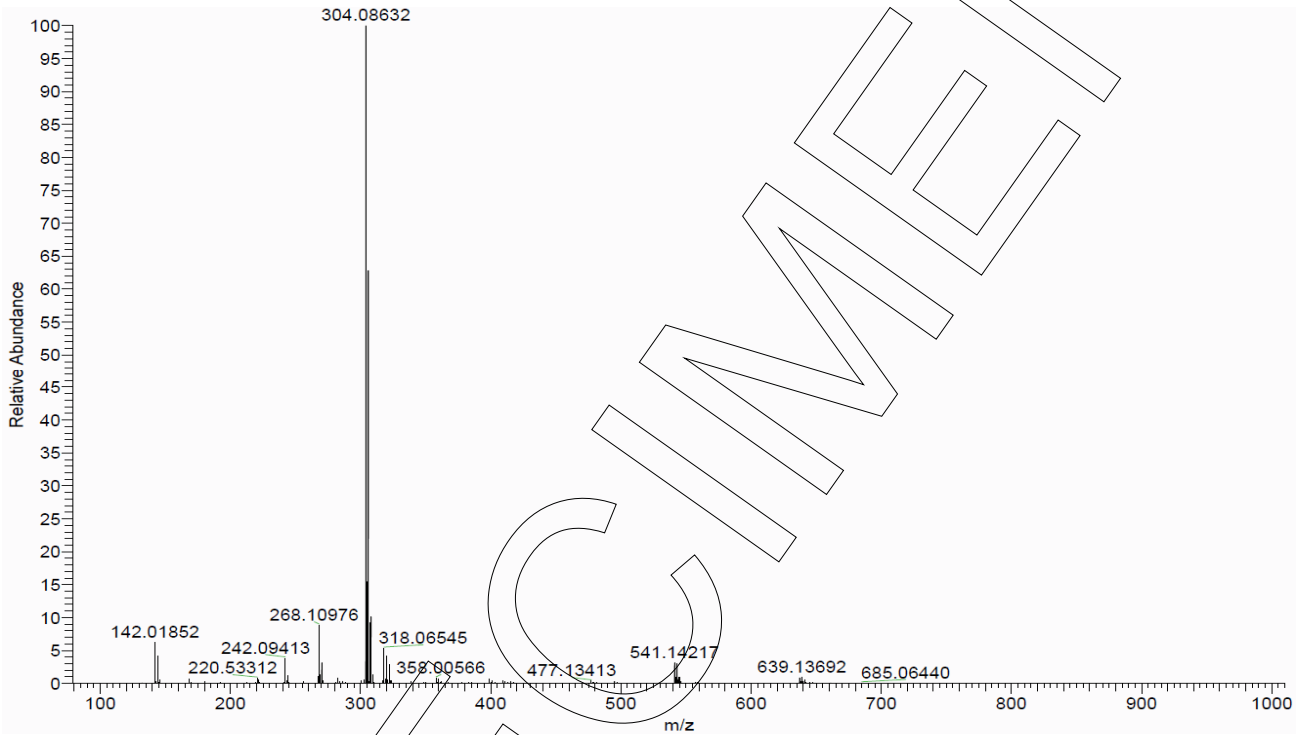
The identity is assessed by ISO/IEC 17025 accredited testing methods.

Method	Conditions	Result
¹ H-NMR	400 MHz, DMSO-d ₆	Structure confirmed



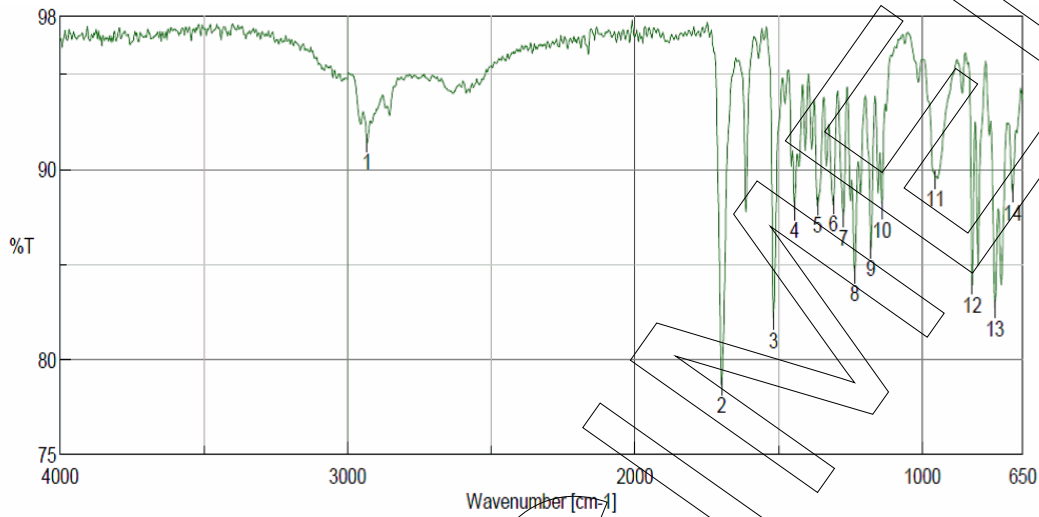


Method	Conditions	Result
MS	3.5 kV ESI+; capillary temperature: 269 °C Theoretical value: 304.08656	Structure confirmed





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



No.	Position	Intensity
1	2932.23	91.371
2	1698.02	78.5766
3	1517.7	82.0092
4	1444.42	87.778
5	1364.39	88.0412
6	1309.43	88.1093
7	1274.72	87.3957
8	1235.18	84.4507
9	1178.29	85.7774
10	1139.72	87.8149
11	954.591	89.4387
12	826.348	83.8552
13	747.281	82.6248
14	685.57	88.7133

Revision table

Revision	Date	Reason for revision
00	06 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.